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NOTES AND COMMENTS

Cuba and the World Free Market.

Once again, the situation in Cuba has been the principal factor affecting the free market price of raw sugar. Last year, the removal of limitations on production meant that all eyes were on the production figures as they were announced ; this year it has been the political situation which has been the deciding factor. Estimates and reports of increased production in various parts of the world had tended to weaken the spot price of sugar, so that when the repeatedly-promised general strike in Cuba was announced, the price recovered sharply. The failure of the rebels' call to strike action and revolt against the BATISTA Government soon became apparent and has been reflected in the drop which occurred after the Easter recess.

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British Sugar Corporation Results, 1957/58.

Last season's sugar beet crop which, according to *British Sugar Beet Review*,[1] the organ of the British Sugar Corporation, produced 4,539,000 tons, was 629,000 tons below that of the previous season but slightly above the ten year average. The average yield was 11·20 tons per acre, compared with 12·65 tons for the previous season and with a ten-year average of 11·16 tons.

Average sugar content was 15·3% compared with 16·1% in the previous season. The reduced tonnage and lower sugar content are reflected in a lower production of sugar which was about 554,000 tons, white sugar equivalent, compared with 692,000 tons in 1956/57. Production of dried sugar beet pulp was more than 300,000 tons.

The factories had a smooth run, free from technical breakdowns, but the duration of operations was shorter than usual. Consumption of coal and labour per ton of beet worked were again the lowest on record.

The poorer agricultural results are attributed in the first instance to the autumn of 1956 which was wet and mild and much of the land coming to sugar beet was ploughed in in a wet condition. There were few winter frosts, the spring was dry and difficulty was experienced in preparing seedbeds, particularly on the stronger lands.

These conditions were in due course followed by very early infestations of viruliferous aphids, which resulted in severe outbreaks of virus yellows disease. The yellows epidemic in Great Britain in 1957 was as severe as, if not more severe than any recorded. Although it was not so widespread as that of 1949, it occurred earlier in the south and south-east of England, and because of this it resulted in greater reductions in yield. This serious and early outbreak was unexpected, for the disease had been decreasing steadily during the preceding few years and in 1956 had reached the lowest incidence for a long time.

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The World Sugar Economy.

A Special Edition of the *International Sugar Report*,[2] published by F. O. LICHT K.G., is devoted to the position of the world sugar economy. It contains a comprehensive statistical analysis by S. MIELKE, backed by tables of data of world cane and beet sugar production, and by countries ; net imports and exports on the free world sugar market, and a world sugar balance. An interesting feature is a survey of the trend towards sugar mill and refinery expansion in the various countries of the world. Part of Herr MIELKE'S review is given below :

"While in the campaign years 1954/55 and 1955/56 the increases in world sugar production were far below the increase in world sugar consumption, with a consequent reduction of stocks, the trend of development was reversed in 1956/57. In that year world sugar production increased by 2,597,000 metric tons raw value (or 6·6%). While world sugar consumption indicated a record increase of 1,958,000 tons (or 4·8%) this increase remained below that of production.

"This latter development appears to be continuing during the current campaign year 1957/58 at an accelerated rate. While we expect a total increase of production of 3,050,000 tons or 7·3% we believe that world sugar consumption will be increased by "only" 1,670,000 tons or 3·9%. World sugar stocks,

[1] 1958, **26**, 108.
[2] 1958, **90**, (3),

after several years of reduction, will for the first time again increase considerably, by an estimated 1,372,000 tons.

"After a considerable expansion in the world sugar trade in the past three years a set-back will not be avoidable this year. The increases, in each case as compared with the previous year, were 324,000 tons in 1954/55, 446,000 tons in 1955/56 and 698,000 tons in 1956/57. As against this, we expect a decrease of the total world sugar trade by 960,000 tons or 5·6% during 1957/58.

"Although the relation of total supplies (production) and total demand (consumption) is of great importance it matters a great deal what this relation is in the various areas and markets. The question is, above all, whether the supply-demand relation expected for the whole world also holds true in the free market. On the world free sugar market generally hardly one third of the total world sugar trade volume is turned over. Even in the calendar year 1957 when particularly large amounts of sugar found their way to the world free market the total turn-over represented, at 6·3 million tons raw value, only 36·7% of the total world sugar trade in the campaign year 1956/57.

"We estimate the 1957/58 world sugar production at 45,229,000 metric tons raw value compared with 41,839,000 tons last year. The total increase thus is about 3,390,000 tons or 8·1%. Of this increase the world beet sugar industry has the lion's share. It was able to increase its production by 2,053,000 tons or 12·4%. This increase, which took place mainly in Europe, is only to a rather small extent due to an expansion of sugar beet growing induced by the high world market prices. Only in countries such as Uruguay, Chile, Japan and China where an expansion of the area has taken place might this motive have played a rôle. One may also say, however, that in those countries the sugar industry had been in the process of expansion when the boom on the world free sugar market set in and that the boom but stimulated the process already going on. The expansion of sugar beet cultivation in U.S.A. was not a result of developments on the world free market but of the changes in the U.S. Sugar Act which came into force in 1957. In Europe eventually where production increased by as much as 1,811,000 tons the sugar beet area was not at all expanded in 1957. Rather the increase in production was exclusively due to the weather which was considerably better than in the preceding year.

"In the cane sugar sector production increased by 1,337,000 tons or 5·3% to 26,629,000 tons. The rate of increase of world cane sugar production is substantially below that of total world sugar production and only little above the expected increase of world sugar consumption. Thus in the cane sugar sector as well it is not justifiable to speak of an excessive expansion of production stimulated by high prices. This difference appears to us to be of importance inasmuch as it shows that the world cane sugar industry does appear to have taken warning from the Korean boom and the following depression.

"It is to be expected that in the 1958/59 campaign there will only be a normal increase in world sugar production as even unusually favourable weather in Europe would not anew lead to such a heavy increase of production, since in the just completed season many European countries have reached their top yields."

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Brazil and the International Sugar Agreement.

Press reports from Brazil indicate that this country will be sending delegates to the meetings to be held next September to work out a new International Sugar Agreement. This does not mean that Brazil will necessarily accede to the new Agreement, but it is understood that the I.A.A. is considering such a step provided that Brazil is awarded a quota of 700,000 tons of sugar which is considered to be an average exportable surplus. Mr. ERIC ROLL, Executive Director of the International Sugar Council, has been in Brazil meeting the President of the I.A.A., Sr. GOMES MARANHAO.

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U.K. Beet Price, 1958.

On the 20th March 1958, the Ministry of Agriculture, Fisheries and Food announced for the Agricultural Departments of the United Kingdom, the results of the Annual Review of the economic condition and prospects of the agricultural industry. Among the guaranteed prices listed in an Appendix to the announcement was that of sugar beet which is to remain unchanged at 130s. 6d. per ton, on a basis of 16·5% sugar content.

The *British Sugar Beet Review*[1] comments that "the guarantee (123s. 0d. per ton for sugar beet of 15½% sugar content plus or minus a price differential of 7s. 6d. per ton for each one per cent sugar content) will continue to apply to the produce of the acreage contracted for by the British Sugar Corporation, in agreement with the Government : and for the 1958 harvest, as in recent years, this acreage will not exceed 400,000 acres in England and Wales and 14,600 acres in Scotland.

"In England and Wales the British Sugar Corporation will bear rail transport costs for delivery to factories of sugar beet from the 1958 crop, in excess of such sum as may be declared by the British Transport Commission to represent on August 1, 1958, the average cost per ton of rail freight for 40 miles for sugar beet ; but the Corporation will bear no part of the cost of transporting sugar beet by road. As in previous years, to take account of the transport terms in the Corporation's contract for the purchase of sugar beet for processing in its Scottish factory, the price on which this contract will be based will be 1s. 9d. per ton less than the guaranteed price."

[1] 1958, **26**, 125.

SOME AGRICULTURAL PROBLEMS IN QUEENSLAND

PROCEEDINGS OF THE QUEENSLAND SOCIETY OF SUGAR CANE TECHNOLOGISTS, TWENTY-FOURTH CONFERENCE, 1957.

PROBLEMS relating to the factory provided the major interest at the Conference and relatively few papers dealt with agriculture. The first requirement for agriculture is the existence of soil wherein to grow the plant, a requirement which has too often been overlooked in the past with the result that vast areas have gone out of cultivation through erosion and even vaster areas suffered a loss of fertility in varying degree. The extent to which erosion will take place under defined climatic conditions varies widely with the character of the soil, and a good example of this is given by A. R. TAYLOR in his paper on attempts at soil conservation on South Johnstone farms. Of the three major types of soil found in the area it is the red volcanic loam found on hillsides that is the chief offender. No systematic means of control has been adopted, but certain farmers have made valiant efforts to check erosion and the several procedures adopted, all of which involve some system of contour planting combined in cases with prior contour ploughing, are described. The account indicates well what can be accomplished with simple, home-made appliances for determining contours.

Poor ratooning in the Bundaberg district during 1956 is the subject of a paper by R. B. MOLLER. The trouble appears to have assumed growing importance since 1950 and in 1955 became the subject of detailed investigation. This investigation is in its early stages but the most notable observation is the association of *Chiromyza* (Soldier Fly), *Rhyparida* spp. and "earth pearls" with ratoon failures. With these may be associated "stubble fermentation" resulting from bleeding. There is no clear evidence of differential varietal susceptibility.

Another matter which is giving cause for anxiety is the drop in the quality ratio, particularly in the wetter areas ; it is discussed by N. J. KING in a study of low c.c.s. at Babinda. The drop has been particularly sharp since 1953 and during the period the most obvious modification in practice has been the increased contribution to the crop by Pindar : from 2% in 1951 to 48% in 1955. The popularity of Pindar lies in its vigour, but its five year c.c.s. average is 0·39 units below mill average for the same period while Badila has an average of 0·17 units above. Q 57, now finding favour, in the last two seasons had averages of 1·39 and 0·86 units c.c.s. above mill average. Other contributory causes appear to be overburning—a practice to ensure a regular supply which has increased since the introduction of the 40 hour week, and mechanical loading leading to increased dirt. This tendency to overburning gives added importance to the study of the nature of the deterioration taking place between harvest and milling, a subject discussed by A. G. BARRIE in his paper on varietal differences in post-harvest cane deterioration. He shows that inversion is primarily responsible for deterioration and that there are considerable varietal differences in its rate, especially after some 6 days and he gives some indication that resistant varieties might be bred. Another, but intermittent source of deterioration is from cyclones and certain analyses are given by J. F. KENNY and J. P. KOMEN in their paper on chemical analyses of cylone-damaged cane. These are of Pindar which was extensively decapitated in the cyclone of March 1956, and the analyses cover the several regions of the stalk.

An indication of the rapidity with which varietal changes have taken place in recent years is given by S. GREENAWAY in "What Q 50 has meant to the Central District." M 1900 was the dominant cane (over 80% of the crop) when war broke out. It was followed by Q 28, approved in 1942, with a meteoric rise to 52% of the crop in 1948 and an equally meteoric fall in 1955 to 2·3%. Q 50 (POJ 2725 × Co 290) was bred in 1938, released in 1947 and provided 85·6% of the crop in 1955. The various qualities which have led to this result, adaptability, yield, juice quality and resistance to pests and diseases, are noted together with its weaknesses—a tendency to pithiness and proneness to entangled growth with consequent added expense in harvesting.

The remaining agricultural paper, by E. H. Fox deals with germination following hot water treatment. The main objective of the experiments described was the determination of varietal differences, if any, under temperature ranges of 50°–52°C and exposure ranges from 1½—3 hrs. This is not the first experiment of its kind and, though varietal responses have been found, the order of resistance to the successive intensities of both factors has been subject to seasonal changes.

H.M.-L.

The Application of "Aldrin" and "Dieldrin" against Termites. C. THAKUR *et al. Ind. J. Sugarcane Res. Dev.*, 1957, **1**, 223–226.—Under Bihar conditions, application in the furrow or on the setts at planting time proved most effective.

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Studies in Sampling Technique for Borer. R. C. ACHARYA *et al. Ind. J. Sugarcane Res. Dev.*, 1957, **1**, 227–229.—Systematic sampling was found to be superior to random sampling.

GLEANINGS FROM INDIA

The succeeding gleanings are gathered from recent issues of *Indian Sugar*.

Cultural Practice.

A SIMPLE 3-row planter, designed at the Indian Institute of Sugar Cane Research, Lucknow, for use with a Fordson Major tractor, is described by R. G. MENON. (**6**, 673-680). Three operators feed the setts and labour is also required to fill spare boxes of setts for replacement at the end of the row and to refill the fertilizer hopper. Covering is done by subsequent ploughing and levelling. Costs work out to Rs 12·71 per acre with a cover of 6 acres per day. This is compared with Rs 18·40 for hand and bullock labour but, where so much of the cane is peasant grown in small blocks ill adapted to mechanization, using family labour for which payment is not made and where some complex organization would be required to finance purchase of, and to ensure the economic use of a Fordson Major, it is very doubtful if these figures, drawn from experience on a 550 acre farm, have any wide significance.

An anonymous article (**7**, 159, 160) briefly discusses the problem of securing adequate organic matter in the soil, a problem arising in the past—and perhaps still continuing—from the use of cattle droppings as fuel. Oil cakes and green manuring are two sources of organic matter, but the main subject discussed is the incorporation of cane residues, particularly trash, in the soil. The danger of ploughing in the trash too deeply is recognized and a "harrow plough", with close-set discs, is recommended if a "Rotavator', is not available. "Sub-trash" cultivation is recommended in a rain-fed or sprinkler-irrigated crop. This, apparently, is the practice commonly termed trash mulching.

With recognition of the importance of organic matter in the soil and an increasing tendency to associate distilleries with sugar factories, the possibility of making use of spent wash as a source of supply is considered in two papers. H. P. SINGH and N. S. SINHA (**7**, 91–93), working at Shahjahanpur, trace nitrification up to the 14th week in samples of 500 g soil with spent wash up to water holding capacity and lime equivalent to 1 and 0·5 ton per acre, and up to ⅓ water holding capacity with the same two equivalents of lime. In both cases, nitrification was increased by the addition of lime, but was considerably greater at the ⅓ water holding capacity level. The approach by N. V. MOHAN RAO and W. THIRUMULA RAO (**7**, 281, 282) is different. At Anakapalle, distillery slops are used to make compost from cane trash and compared with composts using pig or cow droppings or press mud cake. Compost from the slops was richer in N than the remainder, richer in P_2O_5 than all but the press mud compost but lowest in K_2O. Its general composition was good and it matured in 4 to 4·5 months, approximately 14 days earlier than the remainder.

With the introduction of the Co varieties of cane into Uttar Pradesh the practice of ratooning is extending and ratoon crops up to third and fourth ratoons occupy some 33% of the total cane area. But yields are low and this is responsible for lowering the average yield per acre for the Province. The possibility of raising the yield of ratoons is discussed by R. K. TANDON *et al.* (**7**, 215–219). Much depends on varietal choice; Co 650 gives a good yield of plant cane but a poor ratoon yield, 13 tons per acre on the average of 6 centres, while comparable yields of 36·8 and 35 tons have been obtained with CoS 245 and CoS 321. Beneficial cultural practices include harvesting such crops as it is intended to ratoon between mid-February and mid-April as the weather warms up and sowing a catch crop of "guar" (*Cyamopsis psoraloides*) which, in addition to giving some 3½ tons early fodder, resulted in a 10% increase in cane yield. Trials indicate that 120 lb N, half as cake and half as ammonium sulphate and applied half at harvest and the remainder when the rains break, yield the maximum crop. The net additional income per acre as measured over 7 years has been found to be for 1st, 2nd and 3rd ratoons respectively Rs 311, Rs 272 and Rs 277.

The inversion of molasses is readily accomplished and N. V. M. RAO and G. N. RAO (**7**, 277–279) report some preliminary trials of spraying sugar cane in September and October with 100 gallons per acre containing 50 and 100 lb of such molasses. Increased sucrose in the cane was found a month after spraying and it is suggested that such spraying might yield results comparable with early planting or withholding irrigation.

Varieties.

India's second 5-year plan aims at producing 2·25m tons of sugar. To attain this, 39 new factories have been licenced, but the basic problem is increased cane production and, behind that, improved varieties. In the South, Co 419 occupies more than 90% of the cane acreage. N. L. DUTT and J. T. RAO (7, 53–55) give descriptions of some of the more promising later products of Coimbatore.

Improvement of the cane crop in eastern Uttar Pradesh is rendered difficult owing to the smallness and scattered nature of the peasant holdings and the poverty, with consequent backwardness, of the peasants themselves. These difficulties were added to when the two favoured canes, Co 453 and Co 513, succumbed to red rot. M. SINGH *et al.* (**7**, 61–67) give descriptions of two new and promising varieties, CoS 443 and CoS 416, together with data of comparative yields covering 3 years (Co 453 standard). Both are resistant to red rot.

Pests and Diseases.

H. SINGH *et al.* (**6**, 737–742) describe a new Pyralid borer, *Bissetia steniellus*, first recognized as causing serious damage in the Gurdaspur district but since affecting the surrounding area. Its life history is described and is similar to that of most other borers with hibernation in the stubble after October. Control measures are discussed but the same difficulties are met with as with other borers.

The same three authors (**7**, 223–226) also discuss the incidence and control of *Pyrilla* which, in India is like the poor, always with us. A study of the incidence in the years 1949/55 indicate a marked correlation with the total rainfall during June. The most effective and cheapest spray was 0·005–0·01% "Endrin" (0·08–0·16 lb insecticide per acre). Financial calculations in the case of a crop largely peasant grown have little meaning, but the relative costs of power and hand spraying are calculated to be Rs 4·7 and Rs 6·5 respectively.

The chemical control of borers in sugar cane is discussed in much detail by B. D. GUPTA and P. N. AVASTHY (**7**, 69–78). The general conclusion is that effectiveness of a chemical is proportionate to the duration of the residual toxicity. The inaccessibility of the borers suggests, however, that chemical control alone will not be effective and programmes are drawn up for the various areas, according to the particular species common therein, which include, in addition to spraying, collection of egg masses, light traps and the destruction of stubble and cane tops.

G. LAL (**7**, 57–60) describes a system of field sampling measuring the damage done respectively by borer, wilting, smut and jackals. He suggests the system might be of use in the case of new varieties undergoing field multiplication. J. C. SRIVASTAVA (**6**, 743) briefly compares the wet (dipping setts in BHC solution) and the dry (dusting with BHC on planting) methods.

An outbreak of rust, attributed to *Puccinia kuehnii* is briefly reported from Uttar Pradesh by R. K. TANDON *et al.*. Only the uredospore stage has been observed. The main variety affected was CoS 510 but the wild Kans (*S. spontaneum*) was also attacked.

General.

A general account of the system of cultivation adopted in the Hyderabad State is given by S. K. SASTRY (**6**, 694–699). The considerable expansion anticipated during the second 5-year plan with its intensive development schemes is briefly described

H. M.-L.

THE SUGAR CANE IN SOUTH AFRICA

PROCEEDINGS, THIRTIETH ANNUAL CONGRESS, SOUTH AFRICAN SUGAR TECHNOLOGISTS' ASSOCIATION, 1956.

THE major interest at the Congress lay in the discussion of manufacturing aspects of the industry, agriculture being represented by four papers only.

In general terms, trace element deficiencies are conspicuous by their absence from the cane fields. The clearest exception occurs in the Florida Everglades where, as long ago as 1932, R. V. ALLISON found a marked response to copper and manganese, particularly the former, in cane growing on the peat soils. In 1955 patches of cane on the Natal South Coast Sugar Belt appeared chlorotic and very stunted. This was on land which had produced average to above-average crops for 30 years. Affected cane was (*a*) top dressed with 50 lb per acre or (*b*) sprayed with 30 gal per acre of 0·4% copper sulphate at the end of March; by mid-May all symptons had disappeared and by the end of June the treated cane was 2 ft. taller than the untreated. Corresponding treatments with manganese sulphate were ineffective. It appears likely that copper deficiency will be found in other areas. The communication was made by J. L. DU TOIT.

With the relatively short growing season and cold, dry winters, Natal predominately harvests its crop at 24 months with fertilizer applications made normally at planting and, for the ratoon crop, immediately after harvest. To test the adequacy of this practice monthly determinations were made of growth, sucrose accumulation and plant food uptake, and the preliminary results of the plant crop are summarized by the same author. It is noted that main absorption of plant foods is during periods of maximum growth; uptake of nitrogen and phosphate comes practically to a standstill in winter with an actual loss of potash from the aerial tissues.

The check on germination of cane setts infected by mealybug has been earlier recorded by J. DICK[1]. That this check is not due merely to the loss of juice absorbed in feeding would appear from further work described by the same author. Inoculation of an extract of mealybug severely checked germination and subsequent growth, suggestive of a toxin. Added probability was given to this conclusion since a yeast, the only organism extracted from the sett tissues after the cut ends had been dipped in the mealybug extract, produced only a slight depression in setts so dipped in yeast culture.

The last paper by E. STEWARD, gives recommendations for controlling weeds in plant cane as based on certain trials.

H M.-L.

[1] *I.S.J.*, 1954, **56**, 4.

THE SUGAR CANE IN PAKISTAN

THE difficulties attendant on securing viable fuzz in the Central and Western tracts of the former Northern India had led to a system under which fuzz was supplied to these tracts from Coimbatore. With the partition in 1947, the supply to the latter tract, now termed Pakistan, ceased, and a means of raising fuzz locally was sought. The search took two directions; the tendency of sugar cane to arrow at high altitudes was called into play by cultivating at some 3000 to 4000 ft in the neighbourhood of Murree and, at Lyallpur, cane in which the primordia had already formed, were exposed to strong illumination at night. Reference has already been made to the earlier stages of this work[1] and later progress is reported in the summaries of the Annual Reports, the Sugar Cane Research Section, Lyallpur, for 1955/56 and 1956/57 supplied by N. D. YUSUF.

At high altitudes, heavy storms did much damage in the earlier year, and it is noteworthy that the damage occurred to the arrowed heads towards the end of April, while, in the later year, arrowing is reported as commencing at the end of April. This may be compared with an arrowing period in January/February, earlier reported, for most varieties when first grown under these conditions. In 1955/56 viable fuzz was obtained from 13 out of 25 varieties, and in 1956/57 an incompleted total of 14 varieties out of 36.

Of the ten varieties subjected to light treatment at Lyallpur in the earlier year, two failed to respond and only six yielded viable fuzz; in the later year, 11 of the 20 treated arrowed, but only seven yielded viable fuzz. S 1798, a thick cane, yielded 1100 seedlings, the highest yield obtained.

Seedlings from fuzz obtained from both the above sources in 1954 have reached maturity and include, among the total of some 2500, some very vigorous thin types with 60–70 upright stalks and a number of thick types with 25–30 stalks; they are mainly derived from Co 312 and CoK 30.

The varietal position may be summed up as follows. Co 312, first approved in 1934, soon became almost exclusively grown, but by 1949 it had almost completely "run out" with no replacement in sight. The next five years saw CoL 29, CoK 30 and CoL 38 approved as early varieties and CoL 44 as a late variety. None of the seedlings raised from the last fuzz received from Coimbatore have survived the trials nor have those raised from fuzz received from Mauritius, though there remain under trial some of the seedlings raised from fuzz from Barbados. The most promising of the varieties undergoing final trials is CoL 54, which has outyielded all others included in the tests, among them the standards CoL 29 and CoL 44. CoL numbers 54, 53, 50, 48 and 46 are promising varieties being tried out on the experimental farms. H.M.-L.

AGRICULTURAL ABSTRACTS

Determination of Ratoon Stunting Disease by Chemical Means. A. L. FORS. *Bol. Ofic. A.T.A.C.*, 1957, **16,** 431–432.—A test devised by L. L. FARRER[2] and consisting of 10–15 sec immersion of mature nodal sections in 3% hydrogen peroxide, drying, and a 20–30 sec immersion in concentrated hydrochloric acid, with the development of a bluish-green colour, receives confirmation.

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Mechanization in the Sugar Cane Field. M. MITCHIE. *Sugar J.* (La.), 1957, **19,** (12), 14–17, 47.—The progress made in mechanization in the cane fields of Puerto Rico, the potentialities and the problems yet to be solved are discussed.

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Cultivation of Sugar Cane with Nitrogen Fertilizer. G. SAMUELS. *Sugar J.* (La.), 1957, **19,** (12), 43–45.—The efficiency of nitrogen as a fertilizer for sugar cane as measured from a series of trials in Puerto Rico, is expressed in terms of cane (tons) and sugar (lb) per acre/month. Comparison with Hawaii shows that, for the production of 0·5 ton cane per acre/month or over, N consumption per acre is practically the same, but that, in Hawaii, consumption per month is lower by 1 lb per ton cane and 6 lb per ton sugar.

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Sugar Co-operatives in Puerto Rico. J. A. MENDEZ. *Sugar J.* (La.), 1957, **19,** (12), 48–50.—Wherever peasant cultivation is in operation there arises the problem of how to stimulate efficiency. The alternative appears to lie between co-partnership, such as is now being tried in British Guiana, and co-operation. Here is described the progress made in Puerto Rico of the latter alternative.

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New Techniques Bring Higher Returns at Tongaat. ANON. *S. African Sugar J.*, 1957, **41,** 801–805.—The major changes in practice are the adoption of trash mulching with subsoiling, overhead spray irrigation (now the sole method and under extension to 4,000 acres), and tractor-trailer transport in place of truck and tramline. With irrigation is being combined disposal of factory effluent.

[1] *I.S.J.*, 1956, **58,** 184.
[2] *Phytopath.*, 1957, **47,** 10.

The Growth and Development of the Sugar Cane Plant. A. McMartin. *S. African Sugar J.*, 1957, **41**, 1001–1009.—The paper forms Bull. No. 3 of the Experiment Station and summarizes a talk given to planters explaining the major influences controlling the vegetative growth of the cane plant from planting of the sett to the ratoon crop. The control of bud dormancy by hormones and, in particular, root development as adapted to the rather droughty conditions in Natal, are explained.

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New Line of Research Opened into Growth Failure Areas. Anon. *S. African Sugar J.*, 1956, **41**, 1011–1012.—Evidence is adduced suggesting that certain growth failures on land of the Tongaat Sugar Co. is due to nematodes (eelworm). Soil sterilization with "Shell EDB" has shown an encouraging response.

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Cane Transport by Tractor and Self-loading Trailer. Anon. *S. African Sugar J.*, 1957, **41**, 989, 991.—A summary is given of a Report of the Zululand Cane Mechanization Committee. Dirt, leaf and trash have often caused trouble when cane is mechanically picked up for loading. Here it is noted, in the course of general description, that loading is simplified if the ground where cane is stacked is first cleared and two grooves chiselled out as channels for the steel rope.

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Ratooning and Ratoon Stunting Disease Control at Lungyen. J. C. Chou. *Taiwan Sugar*, 1957, **4**, (11), 17–22.—Evidence is adduced to show that the weight of ratoon stalks is related to the location of the bud from which they arise relative to the level of the plant sett in the case of first ratoons or of the points of origin of the first ratoon stalks in the case of second ratoons. In stubble shaving, therefore, the cut should be made neither above nor below the upper and lower limit. The upper limit is some 6–8 cm above the basic levels noted. A description of the hot water treatment for ratoon stunting disease together with certain harvest results follow. Both sections are illustrated.

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Cane Diseases and their Control. Anon. *Victorias Milling Co. (Philippines), Release* 1957, (17) ,1-8.—An over-all picture is given of the status of the 5 major diseases and their control, and of the respective varietal resistances. Of the diseases, leaf scorch, *Stagnospora sacchari*, is the most serious.

Cane Pests and their Control. Anon. *Victorias Milling Co. (Philippines), Release*, 1957, (17), 9–15.—A similar picture to the above is given of the pest position, particularly the woolly aphis (*Oregma lanigera*) and the various borers. Numerous insecticides are under trial including "Pestox" as a systemic insecticide lasting two months. Fortunately, it is not toxic to parasitic wasps such as *Trichogramma* of which several species have been imported for mass production and release. *T. australicum* and *T. japonicum* appear to multiply most rapidly.

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Review of Fertilizer Experiments Harvested 1954–55 and 1955–56 in the Victorias Milling District. F. T. Tabayoyong. *Sugar News* (Philippines), 1957, **33**, 521–526.—The results of a number of fertilizer experiments are reviewed as throwing light on the most profitable applications at present cost of fertilizers and price of sugar. Differences occur according to the nature of the soil, but the four most profitable dressings in kg/ha of N, P_2O_5 and K_2O respectively are 180–120–180, 100–80–120, 80–80–120 and 120–120–120. No account is taken of any residual effect.

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The Mismanagement of Negros Soils Should be Corrected. J. J. Mirasol. *Sugar News* (Philippines), 1957, **33**, 536–543.—The article covers the address delivered as Chairman, Division of Agriculture, 5th Annual Convention, Philippine Sugar Technologists. After reviewing the causes of deterioration of the Negros soils, such as erosion and nutrient depletion, recommendations for restoration are given which include economy in the use of commercial fertilizers through the building up of organic matter by conserving instead of burning trash and by the use of other factory wastes, with replacement of superphosphate by finely ground rock phosphate and by liming acid soils.

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New Varieties Released in Taiwan. H. W. Li *et al. Taiwan Sugar*, 1957, **4**, (6), 15–20.—Four newly released varieties, F 137 (F 108 × Co 290), F 138 (PT 41–161 × Co 356), F 139 (34–257 × POJ 2878) and F 140 (PT 43–52 × CP 34–79), are described with numerous yield comparisons of both plant and ratoon crops with N:Co 310 as standard. The first is a thin cane well adapted to marginal and saline lands ; the three latter are adapted to the richer lands with irrigation, but F 138 and F 140 suffered severely as a result of typhoons.

THE PARTICLE SIZE DISTRIBUTION OF ICING SUGAR

By S. HILL and E. G. MULLER (Tate & Lyle Research Laboratory, Keston, Kent)

Introduction

ONE of the important properties by which the quality of a refined sugar is judged is its particle size distribution. Both the average size of the particles and the distribution of the sizes greatly affect the visual appeal of the product and also its technological properties.

In the case of granulated sugar, for instance, there is a distinct preference for a certain average size, though this preferred size may differ from country to country. The distribution of particle sizes is, perhaps, even more important. A wide spread of sizes is very undesirable as it makes the sugar look less attractive.

Turning to icing sugar, the presence of coarse particles is harmful since even a small number of them may mar the appearance of the final iced product. The rheological properties of icing pastes are obviously greatly affected by the size distribution.

The determination of the particle size distribution of granulated sugar is both simple and straightforward. The method described by POWERS[1] is based on sieving. Since the frequency distribution of the sizes is normal (Gaussian) with respect to weight, a straight line is obtained when the cumulative sieving analysis is plotted on arithmetic probability paper. From this plot two parameters are read off which completely specify the distribution:—

The M.A. (mean aperture), defined as the aperture which passes 50% of the sample and is the general measure of the size of the crystals.

The C.V. (coefficient of variation), obtained by dividing the standard deviation of the distribution by its mean:—

$$\text{C.V.} = \frac{84{\cdot}1\%\text{ aperture} - 50\%\text{ aperture}}{50\%\text{ aperture}} \times 100(\%)$$

This is a measure of the spread of the distribution.

An attempt has been made to measure the particle size distribution of icing sugar and apply similar principles, although the methods employed had to be much more complicated. The procedure described in this paper is far too lengthy for use as a routine method, but it served to establish the fundamental shape of the distribution. A rapid routine method has also been developed and the results obtained were compared with those obtained by the fundamental method. The routine method, which is suitable for factory control work, will form the subject of another paper.

Methods

Several methods are available for the determination of the size distributions of powders. Icing sugar is too fine to be sieved conveniently, and even the 150-mesh sieve will only retain about 2–3% of the sample.

Another method of separating icing sugar into fractions is air elutriation. The separation obtained is, however, not very sharp and there is considerable overlap between the fractions.

The direct measurement and counting of the particles under the microscope is impracticable owing to the very wide range of sizes present. The particles of icing sugar range from 0–400 microns. Under a magnification low enough to see the larger sizes the smaller particles would be invisible. Also, for every large particle there are thousands of small ones present, so that one cannot count a significant number of large particles without making the total number counted impossibly large.

Other methods of particle size analysis include the sedimentation method, adsorption methods, etc., but they all have disadvantages.

No single method is adequate for the purpose. The procedure finally selected was that of dividing the whole sample into a set of fractions by elutriation followed by counting under a microscope. The sample was first divided by air elutriation into several fractions of increasing particle size. Each of these fractions contained a sufficiently narrow range of sizes to be graded by comparison against a Patterson globe and circle graticule under a microscope and counted. The frequency distribution within each fraction was calculated and the results of these were combined by further calculation to give the overall size distribution of the sample.

Air Elutriation

When a spherical particle falls freely in a stationary fluid its velocity reaches an equilibrium value when the downward force due to gravity is balanced by the viscous drag of the fluid. At sufficiently small values of Reynolds number, this, when expressed mathematically, becomes Stokes' law:—

$$\frac{4}{3}\pi a^3 (\rho - \sigma) = 6\pi \mu a v$$

$$\text{or } v = \frac{2}{9} \cdot \frac{a^2 (\rho - \sigma)}{\mu}$$

where a = radius of the particle, ρ = density of the particle, σ = density of the fluid, μ = viscosity of the fluid, v = velocity of fall.

A stream of air moving vertically upwards with a velocity v will separate a mixture of spherical particles of uniform density into two groups according to their diameters. Particles whose diameters are less than that given by the above equation will float away in the air stream, while larger particles will remain. For the specific case of sugar particles

[1] *I.S.J.*, 1948, **50**, 149–150.

falling through air, corresponding values of v and diameter d are:—

d (microns):	10	20	40	60	80	100
v (cm/sec):	0·481	1·92	7·70	17·3	30·8	48·1

Icing sugar particles are, of course, not spherical and separation occurs according to their "Stokes diameters". The Stokes diameter is defined as the diameter of a sphere which (at the same density) has the same free falling velocity as the particle in question.

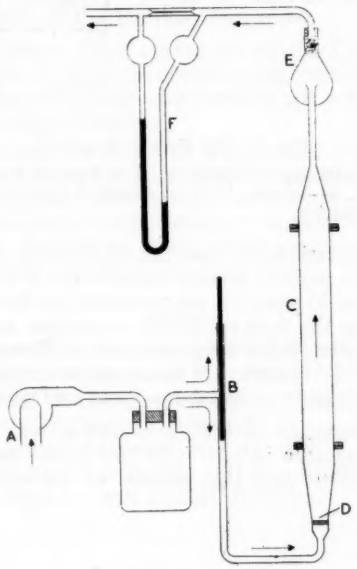


Fig. 1. The Elutriator System.
A—Blower, *B*—Air flow controller, *C*—Elutriator, *D*—Porous disc, *E*—Collector, *F*—Flowmeter.

A suitable air elutriator has been described by KATAN[2]. The apparatus, as modified for our purpose, is shown in Fig. 1. A stream of air is supplied by the blower *A*. The rate of flow through the elutriator is controlled by the needle valve *B*. The elutriator *C* is made of brass. The three sections, bolted together at the airtight flanges, are accurately machined to a circular cross-section and are carefully smoothed inside to prevent turbulent flow. A weighed sample of icing sugar (about 10 gm) is placed on the porous disc *D*. *E* is a glass collector plugged with cotton-wool, and *F* is a capillary flowmeter which has been calibrated previously.

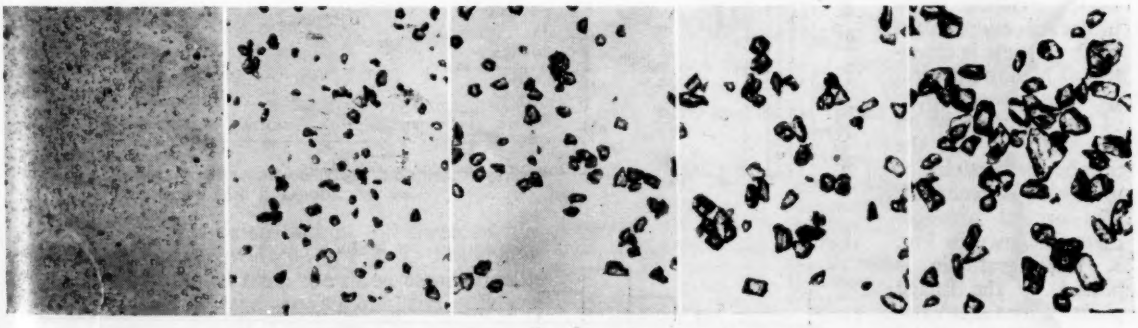
Having adjusted the air-flow to the required linear rate (corresponding to a nominal "Stokes diameter" of 20 microns), the collector is weighed at intervals, and a collection curve plotted. When the rate of collection has dropped to a low value (<100 mg per hour) the flow of air is interrupted and the adhering particles are brushed down from the walls on to the porous disc and a second period of elutriation follows. A striker agitates the sample to prevent the formation of air channels and the sticking together of the finer particles. Owing to slight attrition the rate of collection never falls to zero and elutriation is finally stopped when the rate falls to 50 mg/hr.

The air velocity is then increased to correspond to a nominal 30 microns and the elutriation is repeated, thus collecting the nominal 20–30 micron fraction. The 30–40 and 40–50 micron fractions are similarly collected. The sugar remaining on the porous disc is the fraction > 50 microns.

The total weight collected and the weights remaining on the walls and on the porous disc are added together and balanced against the original weight of the sample. The loss should not exceed 2% and is ignored.

Elutriation is stopped at 50 microns because there is an upper limit to the size that can be separated. This is determined by the necessity for the flow in the elutriator to be stream-lined. Calculation of Reynolds number showed that for a tube diameter of 8·6 cm the linear velocity of air flow must not greatly exceed 16 cm/sec, corresponding to $d = 58$ microns. However, it was found that the >50 micron fraction can be further subdivided by ordinary sieving on 150-mesh sieve (104 microns) into a 50–100 micron and a >100 micron fraction.

[2] *Chem. & Ind.*, 1948, 119.



0–20μ 20–30μ 30–40μ 40–50μ over 50μ.

Fig. 2. Elutriated fractions. (Magnification × 55).

The separation obtained by elutriation can be judged from the photographs reproduced in Fig. 2. They were all taken with the same magnification (55 times).

Unfortunately it is not possible to calculate the particle size distribution directly from the fraction weights, w, for two reasons:—

(1) The fraction limits (say 20–30 microns) are only nominal sizes corresponding to "Stokes diameters" of 20 and 30 microns, not true diameters.

(2) It will be seen from Fig. 2 that every fraction contains a number of particles much smaller than the rest, and also some larger ones. Thus the separation is not really sharp and there is some overlapping between the fractions. One reason for this is that the velocity of the air in the flow tube of the elutriator is not uniform. It varies from zero at the tube wall to a maximum value at the axis. It can be shown that this introduces an uncertainty of $\sqrt{2}$ to 1 in the "Stokes diameter" at which separation occurs. All other fluctuations, caused perhaps by local turbulence near the walls etc. also interfere with sharp separation.

It is therefore necessary to determine the frequency distribution of particle sizes within each fraction.

Microscope Count

The range of particle sizes within each elutriated fraction is considerably reduced, so that it becomes feasible to examine the sample under a microscope. Owing to the comparatively narrow range of sizes a suitable magnification can be selected for each fraction which shows both the largest and smallest particles in the fraction. The fractions are examined by visual comparison with a Patterson globe and circle graticule in a projection microscope. Each particle is classified as having a projected area between those of two of the circles on the graticule, and the number of particles of each size is recorded. The optical arrangement is shown in Fig. 3. The graticule is placed in the image plane of lens L_1. Various magnifications (v/u) must be used for the different fractions to cover the whole range of particle sizes. The particle density on the slide is so arranged that about 30 particles are projected on the graticule. Thereafter the field is shifted at random until about 200 particles have been counted. Three different portions of a sample are examined so that the count of each fraction is based on about 600 particles.

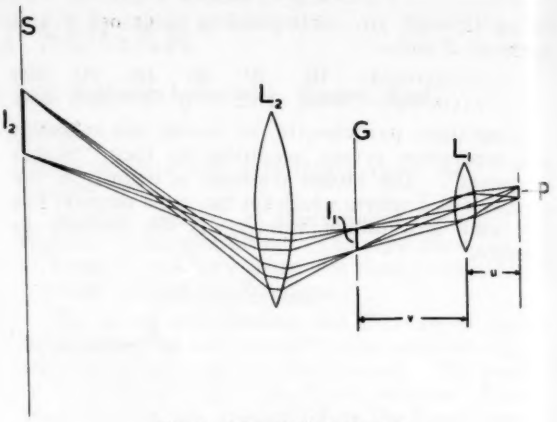


Fig. 3. The Optical Projector.

P—Sugar particle, *G*—Graticule, L_1—Objective lens, L_2—Projector lens, *S*—Screen, I_1—First image of particle, I_2—Final image of particle.

The particles of the "over 100 micron" fraction are comparable in size with the circles marked on the graticule and the sample is therefore placed

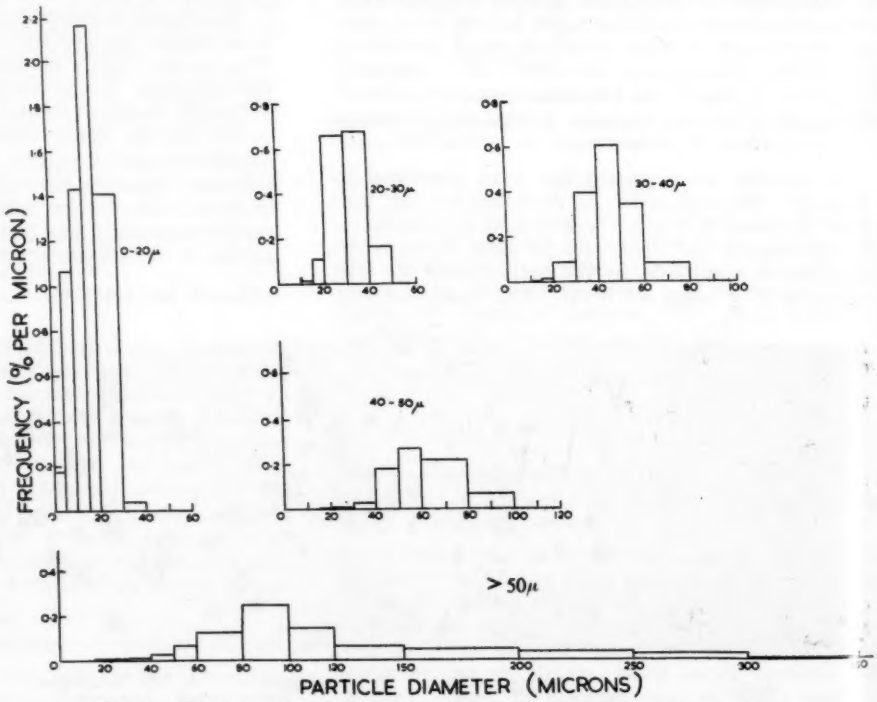


Fig. 4. Frequency Distributions in the Elutriated Fractions, Hammer Mill 1.

directly on the graticule and observed under the microscope.

Calculation of Results

The calculation of the results is both complicated and laborious. For each fraction the cumulative weight frequency distribution is calculated and from it the non-cumulative distribution can be obtained by dividing the percentage lying between certain size limits by the size range or else by measuring the slope of the cumulative curve at various sizes and plotting. This gives a picture of the size distribution in the form of the familiar histograms.

Fig. 4 shows these curves for all the fractions of one sample. It shows the considerable overlap between the elutriator fractions and confirms the necessity for the microscope counting.

The cumulative frequency distribution of the whole sample is obtained as the weighted sum of the cumulative frequency distributions of all the fractions. From the cumulative distribution, the non-cumulative frequency distribution of the whole sample can again be calculated as described above.

Results

The six samples examined were chosen to represent icing sugars manufactured in a variety of ways:—

Three of the samples were milled in hammer mills (hammer mills 1, 2, 3).
Sample 4 was made in a pin mill.
Sample 5 was double milled in hammer mill 1.
Sample 6—type of mill unknown.

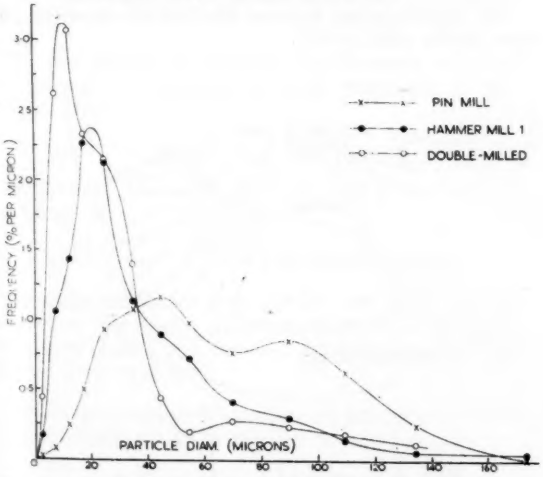


Fig. 5. Frequency Distribution of Whole Samples, Pin Mill, Hammer Mill 1, Double Milled.

The particle size distributions of three of the samples have been reproduced in Fig. 5. The shapes of the curves obtained from the three hammer mills and from Sample 6 were very similar, and only one of them (hammer mill 1) is shown. The reduction of size caused by double milling in the same mill is clearly seen in Fig. 5, and the curves also show the considerable difference between the hammer mill and the pin mill.

The general shape of the curves suggested that the distribution might be log-normal. That is to say, a normal (Gaussian) curve is obtained when the weight frequency distribution is plotted gainst the log of the size. In such a case a plot of the cumulative weight frequency distribution on log-probability paper should give a straight line. Such a relationship is known to apply to a number of aggregates which have been produced by milling[3].

The samples were found to conform to this law over the greater part of the size range, and one such plot is shown in Fig. 6.

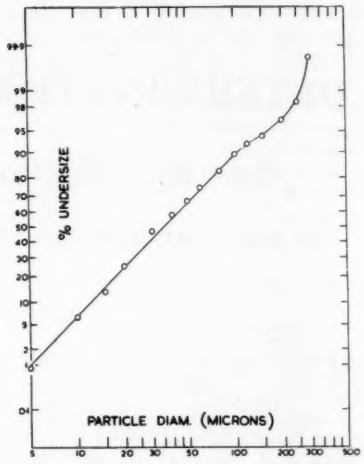


Fig. 6. Cumulative Size Distribution, Hammer Mill 1.

This enables one to describe the distributions in terms of two parameters analogous to the MA—CV notation[4]. The parameters are:

the GMA (geometric mean aperture = 50% aperture), i.e. the aperture which would pass 50% by weight of the sample. This is a measure of the general size of the particles, and

the σ_G (geometric standard deviation) defined as

$$\sigma_G = \frac{84{\cdot}1\%\text{ aperture}}{50\%\text{ aperture}} = \frac{50\%\text{ aperture}}{15{\cdot}9\%\text{ aperture}}$$

This is a measure of the spread of the sizes. The results for the six samples examined obtained from such plots are shown in the table.

Sample	Type	GMA (microns)	σ_G
1	Hammer Mill 1.	35	2·33
2	Hammer Mill 2.	38	2·17
3	Hammer Mill 3.	33	2·31
4	Pin Mill	62	1·85
5	Double Milled	23	2·50
6	Unknown	44	2·15

[3] HERDAN and SMITH: "Small Particle Statistics", (Elsevier, Amsterdam). 1953. p. 113.
[4] DALLAVALLE: "Micromeritics" 2nd Edn. (Pitman, New York). 1948. pp. 51 *et seq.*

The results show that the two parameters GMA and σ_g adequately describe the characteristics of these icing sugars. For example, the effect of double milling is shown by the reduction of the GMA from 35 to 23 microns. The large GMA and small σ_g of the pin mill reflect the fact, also shown in Fig. 5, that this sugar is much coarser but contains no extremes of either fines or very large particles. Hence the relative spread is small. The results also show that the three icing sugars made by the same type of mill (hammer mills 1, 2, 3) are very similar both in average size and in spread.

The methods described are, of course, far too elaborate for the routine control of icing sugar manufacture. Fortunately a rapid method is available which gives, albeit indirectly, a measure of the average size of icing sugars. This routine method, based on a measurement of the specific surface of the sample, will be the subject of another paper.

THE DETERMINATION OF SUGAR IN SUGAR BEETS

Part II. The Preparation of Samples for Analysis.

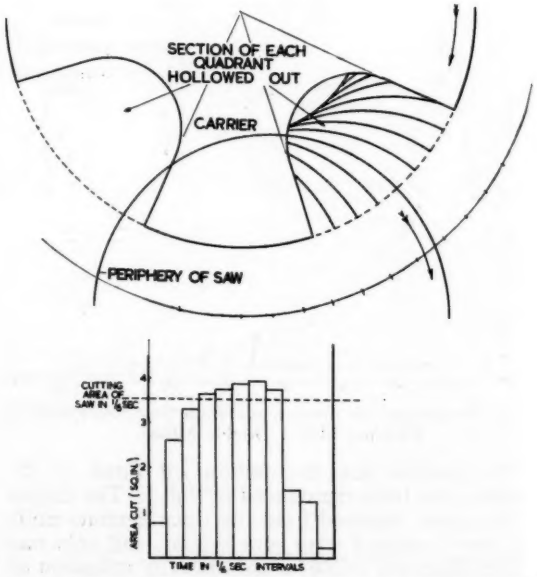
By Wm. H. PARKER, M.Sc.(Birm.), Chief Chemist, British Sugar Corporation Ltd.

Saw Machine Design.

REFERENCE has already been made[1] to the effect of saw speeds on the results obtained in a machine with a fixed rate of "feed". The prototype model was designed with a common drive for saws and "carrier" so that their relative speeds remained constant thus ensuring a constant pressure on the roots during the sawing process for all root conditions. The gearing required to reduce the speed from 600 r.p.m. (the optimum saw speed for this machine) down to 6 r.p.m. for the "carrier" feed was expensive and cumbersome. Practical difficulties were also encountered particularly with "woody" beets. The present design embodying independent drives for saws and carrier feed was accordingly developed, is much less expensive and is a much more practical proposition.

In designing a machine for sawing beet samples the first essential is to maintain the ratio of solid to liquid the same in the "brei" collected from the cut sections as in the whole sample. The ideal arrangement would be to cut every section at right angles to the longitudinal axis of each root, but again this would entail a more elaborate, and costly, mechanism. It is claimed, with the machine now used, that while the cut sections are at various angles to the axes of the roots, sufficient random cuts are made in a normal sample to produce, on average, the same effect for all practical purposes. Any undue pressure of the roots on the saw blades would obviously cause a crushing action with the result that chippings from inefficiently sawn beets would be gouged out. On the other hand, high saw speeds would tend to draw out an undue proportion of juice from the cut surfaces of the roots and the obviously wetter condition of the brei under these conditions confirmed this view.

The figure below depicts the relative positions of saw blades and carrier.


SECTION OF EACH QUADRANT HOLLOWED OUT
CARRIER
PERIPHERY OF SAW
CUTTING AREA OF SAW IN 1/6 SEC
AREA CUT (SQ.IN.)
TIME IN 1/6 SEC INTERVALS

[1] *I.S.J.*, 1958, **60**, 102.

Two of the four hollowed-out quadrants which carry the roots through the cutting process are also shown, one empty and one assumed completely full of beet material, except for the very small portion caused by the distance of the periphery of the saw blades from the carrier spindle. Some clearance is obviously necessary, although in future machines it is intended to arrange for clearances to be left beyond the base of the quadrant so as to ensure that all roots are cut completely through. With the existing machines so small a proportion of each sample escapes cutting completely as not to affect the result materially.

In the full quadrant the progress of the saws through the beet material is depicted for each 1/6th of a second for the whole cutting period which is 2 seconds arrived at as follows :—

The carrier describes one revolution in $\frac{60}{6} = 10$ seconds. Hence the time taken for the "mouth" of a quadrant to pass any given point is $\frac{10 \times 48}{360} = \frac{4}{3}$ or 1·33 seconds, since each quadrant subtends an angle of 48° with the axis of the carrier. However, due to the relative positions of the centres of carrier and saw shafts it will be seen that there is a further 4/6ths of a second cutting period after the saw blades have passed the point *A* in the diagram making the total cutting time 2 seconds for each quadrant were it completely full.

The time intervals of 1/6th sec have accordingly been used merely for the sake of convenience.

The saw blades are 16 inches in diameter with 480 teeth round the periphery, each being set at 45° straight front.

The pitch of the teeth is therefore $\frac{16\pi}{480} = \frac{\pi}{30}$ or 0·105 inches. Therefore the total area of the teeth of the blade is

$$\tfrac{1}{2} \times \frac{(0{\cdot}105)^2}{1} \times \frac{480}{1} = 2{\cdot}65 \text{ square inches.}$$

Now the *maximum* area cut by one blade will be seen from the above diagram to be approximately 4·1 square inches in 1/6th of a second, that is at the rate of 24·6 sq in./sec.

Hence the number of revolutions per second which a blade would make to cut this area would be

$$\frac{24{\cdot}6}{2{\cdot}65} = 9{\cdot}28 \text{ rev/sec or } 557 \text{ r.p.m.}$$

Therefore at the fixed speed of the saws of 480 r.p.m. each quadrant could be filled to $\frac{480}{557} \times 100\%$ or 86·2% of its capacity without any crushing action taking place, a fill which, in practice, is probably very rarely, if ever, achieved due to the shape of the roots leaving many voids.

Saw Blade Design—A Study.

The saw blades used had to be designed so as to ensure the removal of a representative section of beet, in the form of "brei" of such a consistency as to be capable of analysis by the cold water digestion method. This is a totally different function to the normal use of a circular saw. The pitch, shape of teeth, thickness and section were decided after careful tests together with the rate of rotation and the rate of feed of the roots on to the saws.

The development work was carried out with the close collaboration of a manufacturer specialising in this type of work.

Despite satisfactory trials, during the first campaign, when the saws were in general use, there were frequent fractures and collapse of the saws and a thorough investigation was undertaken to find the cause.

Several types of steel had been tried during the experimental period to eliminate failures. During manufacture special care had been taken to detect flaws and cracks. The saws tried out were tempered to various degrees of hardness from 44 to 56 Rockwell "C" scale. Fractures occurred more frequently at higher ranges of hardness.

Many of the fractured blades were examined by expert metallurgists who reported favourably upon the type of steel used and the structure after heat treatment. The cause of the failure was traced to fatigue due to excessive stresses having been imposed. It was suggested that steel containing molybdenum should be tried and the tooth form slightly modified. These recommendations were not regarded as being the complete answer and subsequent events have confirmed this opinion.

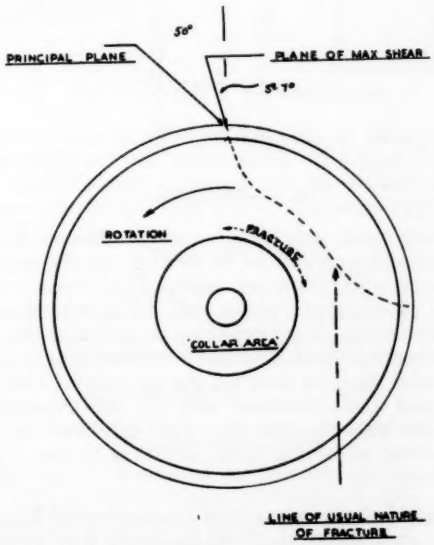


Fig 2.—Usual line of fracture.

The conclusions drawn were that the saws were being stressed, in a certain combination of circumstances, well beyond their limits of endurance. There were two types of fracture involved :

(*i*) commencing at the periphery and running inwards primarily at an angle of 5 to 7 degrees to the radius. Calculations have shown this to be the plane of maximum shear stress. This was the more common type of fracture (See Fig. 2).

(*ii*) at the collar. At this point the blades in many cases sheared, due to the high torque transmitted between the periphery and the collar. This high torque can be shown to occur particularly if the saw is not running freely (also shown in Fig. 2).

Tests were carried out at one of the Corporation's factories to investigate these two points.

In order to reduce the chance of fractures of type (*i*) occurring, the saw blade design was slightly altered, the main differences being that the section was modified to remove stress concentrations by eliminating sudden changes of cross section. This also increased the resistance to bending about the diametral plane. (Fig. 3).

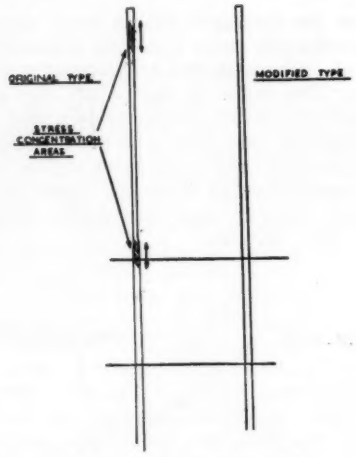


Fig 3.—Saw profiles.

During these tests the saws were subjected to very severe loading conditions by feeding into the machine pieces of wood with an approximate cross section 2 in × 1¾ in and of a length sufficient to extend across the seven saws. It is interesting to note that the peripheral speed of these saws was only 1/5th of the normal peripheral speed of saws for cutting wood. The saws withstood this treatment and careful examination after the tests showed that they exhibited no sign whatsoever of having been subjected to such harsh treatment.

These blades were made of a non-alloy 0·95% plain carbon crucible steel of 44 Rockwell hardness and it was concluded that blades of this type would probably withstand all stress that was likely to be imposed upon them in practice for the purpose of sawing beets.

The saw machines themselves showed that a considerable amount of wear had occurred in the slots of the "carriers", in some cases amounting to 0·05 in, and the blades previously used showed wear on the sides. These points suggested a flexing of the blades which must have been forced against the sides of the slots in the carrier. Saws running under these conditions were bound to fatigue very quickly (see Fig. 4).

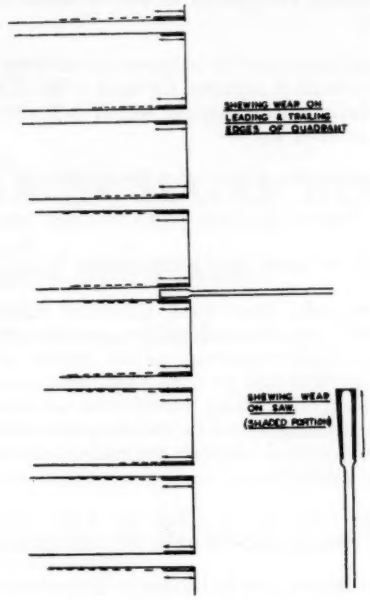


Fig 4.—Wear on carrier and saw.

Factors contributing to the high stresses being imposed on the blades include, according to the manufacturer, the following:—

(*i*) Fibrous beet (bolters) causing choking of the teeth. The teeth choke easily as the fibres pack tightly making it impossible for the teeth to cut their way through the roots. During the special tests mentioned previously it was found necessary to stop the machine and to clean out the teeth of the saws. These had become packed so tightly that a wire brush had to be used. It is therefore recommended that the saws should be examined and brushed clean several times during the day when in continuous use.

(*ii*) Belt slip under heavy load causing a partial check on the speed of the saws which would cause heavy pressure to be built up on the blades. To overcome this the pulleys were weighted (weights are given on the drawings of the saw (see Figs. 3(a) and 3(b) of Part I[1]) to increase the kinetic energy and help to keep the saws running at full speed. Any slowing up would make an appreciable difference to the pressure on the blade.

[1] *I.S.J.*, 1958, **60**, 102.

Also included under this heading is the slip of the saws which could happen if they became slightly loose or were not tightened sufficiently when mounted on the shaft since there has been evidence of a few saws having turned between the "collars". The possibility of driving pins in the "collars" was considered but was not adopted because it would lead to complications when lining up the saw blades, since one fixed collar on the shaft would be necessary.

In this connexion a modification of the spindle was necessary which would result in the tightening nuts being tightened against a collar and not directly against the outside saw blades.

(*iii*) Foreign bodies in the samples, mainly small stones in the fangs or grooves of the beets, no doubt did cause some fractures but they were not considered to be the main cause of the breakages.

(*iv*) Care is necessary when mounting to ensure that the saws do run exactly in the centre of the grooves in the carrier. An easily removed inspection cover assists in achieving this.

The following calculations of the stresses in the saw blades were made using the data obtained during these tests:—

1. *Due to centrifugal action.* These are of the order of only a few lb per sq. in. and can be disregarded when considering stresses of sufficient magnitude to cause fracture.

2. *Due to cutting.* Horse power required by the saws running free 3·6; peak value of horse power when cutting 12·75; lowest speed at which the peak value occurred 460 r.p.m.

Hence the maximum work done by the saws is approximately

$$9 \text{ h.p. and the torque} = \frac{9 \times 33{,}000}{2\pi \times 460} = 102{\cdot}5 \text{ lb/ft.}$$

$$\text{Hence torque transmitted per saw} = \frac{102{\cdot}5}{7} = 14{\cdot}65 \text{lb/ft.}$$

This assumes that the load is shared equally between the saws which is most unlikely. It was felt that doubling this value would give the likely highest value of the torque per saw, say 30 lb/ft.

As the saw is 8 in radius, the load at the periphery will then be $\frac{30 \times 12}{8} = 45$ lb and the area of steel at the periphery is $2 \times 8\pi \times 0{\cdot}130 = 6{\cdot}53$ sq. in., the saw being 0·130 in thick.

Hence the shear stress induced would be 45/6·53 = 7 lb/sq. in.

The load at the collar which is of 3 in radius is similarly calculated to be 120 lb and the shear stress induced 70 lb/sq. in., the blade being 0·09 in thick at the collar.

From these very low stress values, it is obvious that if the saw is cutting freely there can be no possible fracture because the lowest value for this steel at 44 Rockwell hardness is 12 tons/sq. in. If at some time one saw took all the load at peak h.p. value, the stresses induced would still be very small compared with yield point values. It should be pointed out here that if the saw is cutting efficiently, practically no force is required to introduce the material into the saw.

It is therefore reasonable to assume under these conditions that the saws were subjected to forces causing stresses other than those caused by free cutting and centrifugal action.

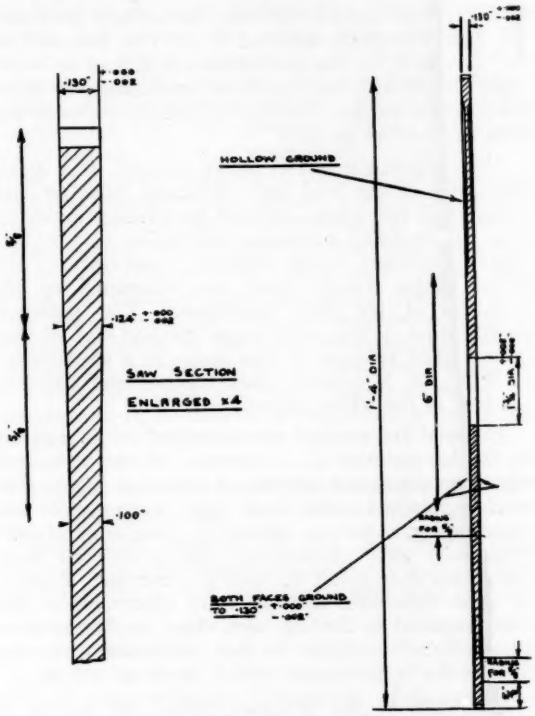


Fig. 5.—Details of saw specification.

Blades were therefore re-designed as shown in the above diagram and the type of steel now used in their manufacture which successfully withstands any reasonable stresses imposed in use is as follows :

STEEL SPECIFICATION :

Carbon	0·85%
Manganese	0·60%
Silicon	0·35%
Sulphur, Phosphorus }	each approx. 0·04%
Rockwell Hardness	44-46

ACKNOWLEDGMENTS.

The author wishes to express his thanks to the Directors of British Sugar Corporation Limited for permission to publish this work and to all those members of the Chemical Control Staff who assisted in the investigations.

INORGANIC CONSTITUENTS OF SUGARS AND SUGAR PRODUCTS

REPORT OF THE SUB-COMMITTEE ON SUBJECT No. 25 TO THE BRITISH NATIONAL COMMITTEE OF I.C.U.M.S.A.

Lead in Lower-grade Sugars and Sugar Products.

IT has been considered that the method proposed (and eventually adopted by the 11th Session[1]) as standard for the determination of lead in white sugars might also be capable of application to many lower grade sugars. Further collaborative work has been carried out on this.

The method for white sugars consists of a direct extraction of the lead with dithizone from an acid solution of the sugar, without preliminary incineration. A modified procedure applicable to raw beet sugar, developed in the Central Laboratory of the British Sugar Corporation, was examined by the members of the Sub-Committee. The principal modification of the white sugar method was to heat the acidified solution of raw sugar at a temperature of 80°C for 5 minutes, then to cool and continue the test as for white sugars.

The modified method was examined collaboratively by the laboratories of 11 members of the Sub-Committee on circulated samples of raw cane sugar. The results obtained with these cane sugars were not encouraging, as various difficulties (emulsions, cloudiness, etc.) were encountered and it did not seem likely that they could be readily overcome. Because of these difficulties and the extra manipulation and time required in dealing with them, most members of the Sub-Committee, in fact, expressed their preference for a procedure which involved ashing.

As stated in the previous report, the ashing of sugars with magnesium nitrate is tedious and time-consuming, though it allows of satisfactory results being obtained in determinations of lead. Ashing with sulphuric acid is less troublesome and quicker, but had been found to give results of somewhat lower precision.

As an alternative to dry ashing, an investigation was made of a shortened form of wet ashing, two procedures being tried. One involved the use of a mixture of 1 ml sulphuric acid, 3 ml perchloric acid, and 2–3 ml nitric acid, the digestion being carried out in a Pyrex test tube, 8 in × 1 in. An amount of sample equivalent to not more than 2 g dry matter was used; in the case of sugar, this was dissolved in about 2 ml distilled water.

The other procedure required the use of nitric and perchloric acids only, 2 g of sugar being treated with 1 ml water, 3 ml nitric acid and 2 ml perchloric acid, followed by a further 3 ml nitric acid later. The digestion was in this case carried out in a 100 ml Pyrex conical flask.

With both procedures, the final determination of the lead was made by the dithizone procedure developed for the direct test on refined white sugars.[2]

Trials of these wet-ashing procedures on a sample of raw cane sugar circulated to the members of the Sub-Committee were reported by 11 laboratories. The results (which averaged about 2·5 p.p.m. lead) showed that there was little to choose between the two procedures, but that there was more variation between different laboratories than was desirable (coefficient of variation about 25%). As it seemed possible, in view of the small amount of sample (2 g) required for the tests, that part of the variation might be due to uneven distribution of the lead, further trials were made on a sample of treacle, to which a known addition of lead had been made. The same procedures as before were used for the wet-ashing and final determination of the lead.

Results of the trials on this sample of treacle, reported by 13 laboratories, showed a much more satisfactory result. The average lead content found by the 13 laboratories was 5·6 p.p.m. by the first procedure and 5·5 p.p.m. by the second, while the actual amount present, as nearly as could be estimated (i.e., the lead originally present plus the added lead), was 5·7 p.p.m. (See Table I). The average recoveries were thus approximately 98% and 97%. The coefficient of variation between the different laboratories was very satisfactory, being as low as 5%. The difference in the results by the two wet-ashing procedures was not significant. The balance of evidence and opinion between the two was in favour of the first (i.e., with sulphuric-perchloric-nitric acids). Its advantages included easier manipulation and its rapidity when suitably carried out. On the other hand, the second (two-acid) procedure is preferable when calcium is present in the sample, as with molasses.

From this work with treacle it seems likely that more consistent results would be obtained with raw sugars by dissolving a larger sample (say 25 g) in water and using an aliquot for determination of the lead. This has not been tried out so far because of the difficulty of procuring a sample of raw sugar with a sufficiently high intrinsic lead content to make the results of interest. It is thought unlikely that the addition of lead to a sugar could be effected with satisfactorily uniform distribution.

In view of the satisfactory results obtained by the wet-ashing and dithizone procedures examined, also

[1] *I.S.J.*, 1955, **57**, 355–358.
[2] See *I.S.J.*, 1955, **57**, 169, 328.

Table I.

RESULTS OF DETERMINATIONS OF LEAD IN SAMPLE OF TREACLE

Wet-ashing procedure

Laboratory	I p.p.m.		II p.p.m.	
I	5·9		5·75	
II	5·1		5·1	
	5·2	5·2	5·1	
	5·2		5·0	5·0
	5·2		5·0	
			5·0	
III	6·0		5·6	5·6
	5·7		5·5	
	5·7	5·7		
	5·7			
	5·6			
IV	5·25	5·3	5·0	5·1
	5·25		5·25	
V	6·2	6·2	6·3	
	6·2		6·5	6·3
			6·0	
VI			5·2	
VII	5·0		6·5	
	6·1	5·4	5·5	
	4·5		5·8	
	6·0		5·5	5·6
			5·3	
			5·2	
			5·3	
VIII	5·46		5·33	5·5
			5·57	
IX	5·3		5·5	
	5·5		5·6	
	5·3	5·4	5·6	5·6
	5·4		5·7	
	5·4		5·5	
	5·4		5·6	
X	5·8		5·2	
	5·9	5·8	5·7	
	5·7		5·0	5·5
			6·1	
			5·7	
XI	5·4		5·7	
	5·3	5·3	6·1	5·7
	5·2		5·3	
XII	5·28	5·6	5·00	5·3
	5·82		5·65	
XIII	5·7		5·4	
	5·7		5·6	5·5
	5·4	5·6	5·4	
	5·6			
	5·6			
	5·6			
Mean of laboratory means		5·58		5·52
Standard deviation of laboratory means		0·29		0·34
Coefficient of variation		5·2%		6·1%

Amount of lead in original treacle before addition of lead:

By digestion method I	0·75 p.p.m.
By digestion method II	0·60 p.p.m.
Mean	0·68 p.p.m.
Lead added	5·00 p.p.m.
whence estimated lead in treacle circulated	5·68 p.p.m.

of the fact that the dithizone procedure is that already adopted by I.C.U.M.S.A. for refined white sugars and (tentatively) for lower grade sugars ashed with magnesium nitrate, the British Sub-Committee proposes these procedures to the Referee for official adoption for the determination of lead in lower-grade liquid sugar products. A full description of the procedures is given in Appendix I.

The same procedures, applied to aliquots of a bulk solution of the sugar, are proposed for tentative adoption for the determination of lead in raw and lower-grade solid sugars.

Determinations of lead after dry ashing (of liquid or solid products) were not further investigated in the work now reported. However, the work done on lower grade sugar in connexion with the previous report had shown that ashing with sulphuric acid could give results agreeing (on the average from 10 laboratories) with those obtained after the troublesome ashing with magnesium nitrate, though the degree of precision was rather lower (coefficient of variation 16%, against 7·5% for magnesium nitrate ash). In view of (1) the simplicity of sulphate ashing, (2) the fact that sulphated ash is already a routine determination, (3) the fact that it is convenient to work with a larger sample than with the recommended wet-ashing procedures (thereby going some way towards nullifying the effects of possible uneven distribution of the lead), it seems desirable to recommend sulphated ashing, followed by the dithizone estimation as after wet-ashing, as an additional tentative method for lower-grade liquid and solid sugar products. A description of a suitable procedure is given in Appendix II.

IRON IN REFINED WHITE SUGARS AND IN LOWER GRADE SUGARS AND SUGAR PRODUCTS.

Preliminary inquiries showed that the methods most favoured for the determination of iron in sugars were the thiocyanate and thioglycollic acid methods.

A sample of a lower-grade sugar was circulated to the members of the Sub-Committee, who were asked to determine iron in it by the method currently in use in each respective laboratory. The results obtained were very scattered (coefficient of variation, 28%, for 12 laboratories, the average iron content found being 8·0 p.p.m.). Methods used included dry or wet ashing, and the use of thiocyanate, thioglycollic acid, or *o*-phenanthroline as reagent.

Another sample of lower-grade sugar was then circulated, the iron to be determined on an aliquot of a filtered solution of 50 g of the sugar. The results were just as scattered as those previously obtained on a solid sugar. There was no particular tendency for a laboratory to obtain a low or a high result on both occasions.

An inspection of the distribution of the results suggested the possibility that some of them might be affected by contamination with iron-containing atmospheric dust, since iron in the form of fine dust may well occur to a variable extent in the atmosphere of laboratories. The extent to which the analysis would be vitiated would depend on a number of factors—the concentration of iron dust in the atmosphere, the area and time of exposure of dishes or

crucibles during ashing procedures, whether a strictly parallel "blank" is carried out and allowed for, and so on.

Further trials are in hand in which the possibility of contamination with atmospheric or adventitious iron will be excluded as far as possible.

Trials have also been made of a "direct" test (i.e., without ashing) for white sugars, using a thiocyanate procedure in which the iron colour is extracted into a mixed solvent, amyl alcohol and amyl acetate, the colour then being matched against standard discs or measured with an absorptiometer or spectrophotometer. Promising results have been obtained when extraneous contamination is eliminated as far as possible and any insoluble iron is removed by filtration. The validity of this last procedure, however, is in some doubt.

Recommendations

(1) That rapid wet-digestion procedures as described in Appendix I, followed by a dithizone procedure essentially the same as that adopted at the 11th Session for the determination of lead in refined white sugars, be adopted for the determination of lead in lower-grade liquid sugar products.

(2) That similar procedures, applied to aliquots of a bulk solution of the sugar, be tentatively adopted for the determination of lead in raw and lower-grade solid sugars.

(3) That sulphated ashing, followed by the same dithizone procedure as following the wet-digestion procedures, be adopted as an additional tentative method to the incineration with magnesium nitrate adopted at the 11th Session.

(4) That study of the determination of iron by the thiocyanate and other colorimetric methods be continued.

Appendix I.

Estimation of Lead in Lower-Grade Liquid Sugar Products

Reagents.— Sulphuric acid, pure concentrated. (Lead not more than 0·005 p.p.m.)

Nitric acid, pure concentrated. (Lead not more than 0·005 p.p.m.).

Perchloric acid, pure 60%. (Lead not more than 0·005 p.p.m.).

Ammonium hydroxide, 0·880 s.g. (Analytical reagent grade, lead not more than 0·005 p.p.m.).

Ammonium citrate solution, 25%. Dissolve 250 g laboratory grade material in water to 1 litre, add 20 ml 0·880 ammonia and extract with a 0·1% solution of dithizone in chloroform until free from metals. Extract excess dithozone remaining in the aqueous phase with successive small portions of chloroform until the aqueous phase is colourless.

Potassium cyanide solution, 5%. Dissolve the analytical reagent grade (lead not more than 0·5 p.p.m.) in lead-free water. (This solution should be at least 2 days old before use, to allow time for oxidation of traces of sulphide).

Dithizone (0·002% approximately) solution in chloroform. Dissolve an appropriate weight of dithizone (not specially purified) in analytical reagent grade chloroform (or in redistilled chloroform with 2% alcohol added to stabilise).

Standard lead solution, 0·1 g lead/100 ml. Dissolve 0·160 g lead nitrate in 1 N nitric acid to 100 ml.

Dilute standard lead solution, 0·001 g lead/100 ml. Prepare by diluting the standard lead solution with lead-free water.

Dilute nitric acid. A 1 : 100 dilution of concentrated nitric acid, analytical reagent grade.

Bromothymol blue. A 0·04% solution in 20% alcohol.

Wet-ashing procedure I (for general use).—Take an amount of liquid sample equivalent to not more than 2 g dry matter. Place it in an 8 in × 1 in resistance test tube scratched at approx. 10 ml and 25 ml levels. Add about 1 ml distilled water and shake to mix with the sample. Add 1 ml sulphuric acid, 3 ml perchloric acid and 3 glass beads, warm if necessary until charring occurs, then add slowly from a teat pipette 2–3 ml conc. nitric acid. Continue digestion until the mixture is clear and almost colourless, adding nitric acid a few drops at a time until charring ceases. Continue heating to drive off most of the residual perchloric acid, leaving a final volume of about 1–2 ml.

Wet-ash procedure II (for use where appreciable amounts of calcium may be present).—Place in a 100 ml conical resistance flask an amount of liquid sample containing not more than 2 g dry matter. Add 1 ml water, 3 ml conc. nitric acid and 2 ml perchloric acid and heat on an electric hot plate, starting the plate from cold. Use a layer of asbestos paper if necessary to moderate the heat. When the liquid turns brown, add further nitric acid dropwise. A colourless solution and white fumes of perchloric acid indicate completion. A total of about 6 ml of nitric acid is required.

Further procedure in either case.—Dilute the cooled digest to 10 ml with distilled water, and boil for about half a minute to dissolve any solid matter present. Add 6 ml ammonium citrate solution and, if the solution is not clear, boil again. Dilute with water to 25 ml, add, from a burette, ammonia until full blue to bromothymol blue, plus 1·5 ml excess, then add 2 ml 5% potassium cyanide solution. Transfer the mixture to a 100 ml separating funnel, washing in with a little water. Add dithizone solution (0·002%) from a 25-ml burette until on moderate shaking an excess is present, (i e., the lower phase has changed from the brick red colour of lead dithizone and has taken on a purplish or blue colour). Shake vigorously for about 30 seconds, and if necessary add more dithizone until excess is again apparent. Transfer the chloroform phase to a second separating funnel, washing through with a few drops of chloroform from a dropping bottle. To the aqueous phase in

the first separating funnel add 2 ml of dithizone solution, and shake.

Transfer the chloroform phase again to the second separating funnel. Then add 10 ml of dilute nitric acid (1 : 100) and shake up until the lead goes into the aqueous phase (indicated by the chloroform phase changing to a pure green colour). Discard the chloroform phase and add to the aqueous phase 0·2 ml ammonium citrate solution, 5 drops ammonia solution (0·880) and 0·2 ml 5% potassium cyanide solution. Add dithizone solution 1 ml at a time until, on shaking, a definite excess is present, i.e., until the chloroform layer becomes a pinkish-purple colour. Shake vigorously for about 30 seconds and if the pinkish-purple colour has become pink, add more dithizone until definite but slight excess is again present. Note the total amount of dithizone solution added to each sample solution (if more than one).

Carry out a blank determination on all the reagents used, taking it through the whole process of digestion and extraction. For the final extraction add to the blank the least amount of dithizone added to any of the samples (if a number are being analysed). Finally add dilute standard lead solution from a 2-ml micro-burette to the "blank" funnel until, on shaking, the colours of the chloroform layers of the sample and blank exactly match. Note the amount of standard lead solution used. Match the lead colours of other sample solutions (if any) in the same way, each time first adding more dithizone solution to the blank until it contains an amount equal to that added to the sample solution which is being estimated.

If x g of sample is taken for the determination, then: 1 ml dilute standard lead solution used for matching $= \frac{10}{x}$ p.p.m. lead in the sample.

Appendix II

Tentative Method for Sulphated Ashing as Alternative to Wet Ashing Procedure.

Reagents.— Sulphuric acid, pure concentrated. (Lead not more than 0·005 p.p.m.).

Hydrochloric acid, pure concentrated. (Lead not more than 0·005 p.p.m.).

Ashing procedure.—Weigh 5 g of sample into a silica or platinum dish. (In the case of solid sugar add distilled water to dissolve to a 65–70°Brix solution). To the liquid (cooled if necessary) add 15–20 drops of sulphuric acid, mix well by swirling round, and carbonise carefully over a small flame or in the furnace at a low temperature. Complete the ashing in the furnace at 450–500°C.

Dissolve the ash in 2 ml concentrated hydrochloric acid, gently swirling this round the dish. Add 15 ml lead-free distilled water, and stand the dish on the boiling water bath for 15 minutes. Then continue as in Appendix I, under "Further procedure in either case", from the point "Add 6 ml ammonium citrate solution. . ."

HAWAIIAN SUGAR STRIKE

THE strike of the International Longshoremen's and Warehousemen's Union (ILWU) against the Hawaiian sugar industry went into the third month in April. Attempts at mediation by both the federal government and the Governor of Hawaii have failed. The Governor's mediator said in his opinion the strike "will not be settled in accordance with the present views of either party, short of complete exhaustion of one or the other."

Only 31,062 tons of Hawaii's more than a million ton quota had been produced prior to February 1, when the strike started. Due to fortunate weather conditions apparently little crop damage has taken place within the first two months following the strike.

More serious to Hawaii for the immediate present is the fact that her refined sugar, which is the only cane available in the Western part of the U.S., is slowly going off the market. All Hawaiian sugar is marketed through the California & Hawaiian Sugar Refining Corp., an agricultural cooperative owned entirely by Hawaii's 27 plantation companies.

The C & H sugar refinery at Crockett, California, which is the largest in the world, has been idle since before the end of February. Some 25,000 tons of Cuban and Philippine raws were purchased and delivered. However parts of the same union on strike in Hawaii operate sections of the mainland plant and C & H recently notified employees that they did not intend to start operations soon. C & H owns a minority interest in the Imperial Sugar Co. at Sugar Land, Texas, and has a long contract to supply raws, but it is now operating on foreign raws. Aiea refinery in Hawaii, owned by C & H, is also closed because of the strike.

Sugar Camera in Hawaii.—A "grain camera" has been developed by G. E. Sloane and H. Iwata, of the sugar technology department of the Experiment Station, Hawaiian Sugar Planters' Association. It permits simple and easy measurement of the size of sugar crystals—and makes a permanent record. The camera is a standard Speed Graphic press camera with a Land Polaroid film back, which allows positive prints to be processed in one minute. A 13 mm focal length lens enables magnification of the sugar crystal by nine to ten diameters. Inside the camera is placed a glass slide with the sugar crystals, lighted from below. In addition, a special glass slide with calibration marks is provided which can be placed over the newly developed print. The requirement in Hawaiian mills is that 75 per cent of the crystals must be at least six tenths of a square millimeter in size to meet quality control standards. Research on the new camera has been under way for more than a year. Six plantations in Hawaii are now equipped to use these cameras on a day to day basis.

SUGAR-HOUSE PRACTICE

New Anti-Corrosive Paints in the Sugar Industry. M. VON MILDENSTEIN. *Zeitsch. Zuckerind.*, 1957, **82,** 223–224.—Double-component anti-corrosive paints, such as the polyurethane and the cold hardening epoxy resin paints, are described. Such paints are very resistant to water, sugar juices, oil, fats, salt solutions and organic solvents, and to heat up to about 150°C and over, up to 100°C in the presence of water vapour.

* * *

Experiences with Vibrating Screens in the Sugar Industry. R. FREUDENBERG. *Zeitsch. Zuckerind.*, 1957, **82,** 225–227.—The use of "Roberg" vibrating sieves in German white sugar factories is discussed. Preliminary snags included overloading of the screening surface with sugar after long periods of idling, which was overcome by installing a shaking shoot, with an adjustable feed valve, between the vertical cooler and the elevators to the sieves, so that the bottom part of the cooling shaft took the load impact, allowing uniform charging of the sieves. Difficulties encountered with excess lubrication of the roller bearings are also described. Increasing screening surface despite lack of space has been effected by installing two or three screens one above the other; a cell feed has been installed before each vibrator, with an emergency overflow beneath. The screening of ground and damp sugar is discussed. "Roberg" sieves have been installed in two post-war factories in Southern Germany.

* * *

Latest Information on the Push-type Centrifugal. E. RÜEGG. *Zeitsch. Zuckerind.*, 1957, **82,** 227–229.—The developments of the Escher-Wyss push-type centrifugal are reviewed and the latest modifications (types C–4/A and C–5) discussed. These are capable of treating material which is difficult to filter and have an improved throughput of 40–80% on the C–4, which means 14–18 tons/hr affined raw sugar. The dimensions of the C–4/A are exactly the same as those of the C–4, the newer machine having a standard vertical centrifuge. The basic construction is unaltered.

* * *

Grain Establishment Investigations during the Seasons 1953–54, 54–55, 55–56 and 56–57. E. BEESLEY and K. W. PEARCE. *Comm. S.M.R.I.*, 1957, (35), 34 pp. Tests are described in which seeding techniques and conductivity control were combined in boiling refined and raw sugar strikes. In the former, it was concluded that while conductivity control is a useful adjunct, boiling is best left to the skill of the pan boiler, because of the marked effect on conductivity of slight variations in ash at such high purities. The high conglomerate formation was not due to the method of graining but rather to poor circulation caused by the obsolete design of the pans. Tests on raw sugar boiling during 1954/56 are described; these led to the development of the "no steam" graining technique. In this, the graining charge is boiled down under normal vacuum and steam supply for about half to two-thirds of the usual boiling-down time. Condenser water is reduced slightly and steam to the calandria reduced considerably. When the conductivity drops to a value roughly equal to that of the metastable zone upper limit, the steam supply, followed *immediately* by the condenser water supply, is shut off. The conductivity drops a few mA (4–5) and then remains constant. The condenser water is re-opened just sufficiently to give brisk boiling with a fair rate of decrease in conductivity (1½ mA per min). The slurry is sucked into the pan when the conductivity is still fairly high in the metastable zone and the spontaneous boiling down continued until the conductivity reaches a value 1–2 mA above that at which to bring the grain together, whereupon the condenser water is again shut off completely. Boiling ends, but there is still some circulation and crystal nuclei continue growing. When grain size is sufficient to be safe from dissolving in the calandria hot zones (30 min in the case of *A*-molasses grain), boiling is restarted by opening the steam valves slightly, then opening the condenser water to its normal extent. The steam valves are adjusted to control conductivity and temperature; when the former starts to drop again, the balancing water feed is turned on and the conductivity held at the desired value for the rest of the bringing together period, the steam supply being increased steadily to the normal value. Tests showed that this technique gave true seeding; it was generally applicable to *A*-molasses graining (and possibly to syrup graining provided a well designed pan is available); no artificial circulation was necessary; and the conductivities and temperatures of the various operations were not critical. Loss of slurry in further tests of the technique was due to the calandria design.

* * *

Evaporator Vessels of Special Design. I. C. G. M. PERK. *S. African Sugar J.*, 1957, **41,** 549–552.—The evaporation of cane juices in a pressure evaporator is discussed, with mention of work carried out in Java in 1928/9, when it was found that no harm occurred provided that retention time was no longer than 9 minutes, (although this proved impractical with defecation and sulphitation juices because of the high rate of scaling). The design requirements for vessels of an evaporator to permit this retention time are discussed and a description given of the Kestner "climbing film" evaporator.

* * *

Boiler Scale. P. T. DUNAEV. *Sakhar. Prom.*, 1957, (5), 46–52.—Boiler scale formation in Russian sugar factories is discussed in detail. Most of the corrosion is attributed to inadequate de-aeration of treated water, and the installation of suitable water-treatment plants is advocated.

Apparatus for Automatic Sugar Bagging. H. DABROWSKI. *Gaz. Cukr.*, 1957, **59**, 126–127.—A prototype automatic bag filler designed by W. ZELEZNIAK is described and compared with the mass-produced "Natromag" filler. Six funnels mounted on a turntable pass in turn beneath a hopper as the table revolves. Fifty kg of granulated sugar is automatically weighed and falls through the funnel to the paper valve-sack. In the case of the "Natromag" the automatically-weighed sugar (50 kg) falls from the hopper through the funnel to an inclined endless belt, whence it passes to a feed pipe and is finally shot into a paper valve-sack. The power requirements of the "Natromag" and the Zelezniak fillers are 0·825 and 0·900 kW respectively. The advantages of the "Natromag" over the other machine are: 5–10% of the sugar remains in the funnels of the Zelezniak filler, which requires two operators as opposed to one with the "Natromag", and which is noisy in operation. The "Natromag", which measures $2 \times 1{\cdot}5 \times 2$ m, may be easily installed under silos, and fills an average of 150–200 bags an hour, with a maximum of 300–350.

* * *

Theory and Practice of the Oil-Fired Shaft Lime Kiln. H. EIGEN. *Zucker*, 1957, **10**, 250–257.—Oil-fired vertical lime kilns are described and illustrated. Flue gas circulation is advocated in view of the resultant mild lime-burning temperatures, with consequent increased kiln lining durability. Sufficient air is available to cool the lime adequately. The complete cross-section of the limestone column is well gassed as the oil gas penetrates to the centre of the oven and, in addition, the waste gas circulation creates a powerful draught in the oven. As a result the lime is not overburnt. The maximum thermal working efficiency of such a kiln is 65%; fuel oil consumption is 10·9% by weight of lime with optimal construction and operation, based on lime with CaO content of 93%. The dry flue gas contains only 31% CO_2, so that the resultant amount of CO_2 per ton of lime is almost as great as with coke-fired kilns. The actual waste gas temperature above the burden is 398°C. When about one-third of the combustion zone waste gas is extracted from the lowest pre-heating zone at 900°C and is used for steam production, the flue gas temperature drops back to 113°C. The heat consumption of 1071 kcal/kg of lime drops to 862 kcal if the heat in the waste gas stream (209 kcal) is made available. Graphs and diagrams are included and the costs of fuel discussed.

* * *

Technological Performance Data for a Continuous Pulsating Escher-Wyss Centrifugal in a Refinery. E. A. GUSEV. *Sakhar. Prom.*, 1957, (6), 17–21.—The performance of two Escher-Wyss continuous centrifugals for refinery massecuites is discussed with the help of tabulated results. Using one such centrifugal for first and another for second product massecuite an output of 400 tons/day is said to be easily attainable. Experience at Krasnopresnensk refinery has shown these centrifugals to be simple to operate.

Truck Loader VP-2. V. F. KONYAKIN and B. F. CHERNOGUB. *Sakhar. Prom.*, 1957, (6), 29–30.—A telescopic belt conveyor driven by a 1·7 kW motor is described. The framework supporting the belt may be extended to 7·2 m from 4·7 m, the angle of inclination being variable between 15° and 23°. The conveyor is not suitable for use with a main conveyor from warehouse to railway siding.

* * *

The "Saccharoscope". N. A. SHIBKO. *Sakhar. Prom.*, 1957, (6), 35–36.—This optical device permits observation of crystal growth in the vacuum pan, to which it is directly attached. The crystals are magnified 25 times on to a screen, an electric lamp serving as light source. Image reflection on to the screen is produced by two adjustable mirrors, the lens used having a focal length of 28 mm. A full description of the instrument is given together with a diagram.

* * *

Increasing the Capacity of White Sugar Hoppers. V. N. TRET'YAKOV. *Sakhar. Prom.*, 1957, (6), 37.—A 50% capacity increase was effected by increasing the height of the hoppers at Karabulak factory. Sugar is now fed up an inclined belt conveyor and drops on to a horizontal belt conveyor which can move across the top of the three hoppers to allow sugar to drop into the one selected.

* * *

Crushing of Limestone at Kapitanov Sugar Factory. S. M. VOLOKH. *Sakhar. Prom.*, 1957, (6), 40–41.—Limestone lumps of 20–40 kg weight are broken down to a size of 120×150 mm by passing them from the rail trucks to a crusher, from there by inclined conveyor to a sieve, whence they fall by gravity to bunkers, to be finally taken by skip hoist to the lime kiln, or, if too small, to dumping trucks. Four men operate the crusher, which crushes 8 tons per hour. Fine stone unsuitable for the kiln constitutes 5% by wt. of crushed stone.

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Combined Method of Drying Pressed Refined Sugar. C. KH. ABDURAZAKOVA. *Sakhar. Prom.*, 1957, (6), 53–55.—A drying process is described in which moist sugar is dried first with hot air, then in a high-frequency field, and finally with cool air.

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Increasing White Sugar Yield. D. V. GORBAN' and L. C. TVERDOKHLEBOV. *Sakhar. Prom.*, 1957, (7), 20–23.—Water consumed in sugar washing is discussed in relation to the colour and sugar yield. Results of tests carried out are tabulated and shown graphically.

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Regulating the Work of Sugar Factory Lime Sections. M. D. TSERMAN and E. D. SHMAGAILO. *Sakhar. Prom.*, 1957, (7), 24–26.—The poor organization in the lime sections of older sugar factories prevented proper cleaning, etc. Improvements carried out at

Kreshchatik factory were brought about by relocation of the equipment. The slakers were raised and a skip hoist installed to feed the lime to these. This hoist is fully described and shown diagrammatically.

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"Alkathene"-Lined Jute Fabrics as Packing Materials for Gur in Storage and Transport. K. L. KHANNA, A. S. CHACRAVARTI and M. FAROOQUE. *Indian Sugar*, 1957, **6**, 731–734.—The results of tests in which gur was stored in jute bags lined with polyethylene indicated that this prevented the deterioration taking place as a result of moisture absorption. The lined bags were also recommended for white sugar storage.

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Maintenance Scheduling and Procedure for Evaporator Tubes. A. JOHN. *Sugar y Azúcar*, 1957, **52**, (5) 23–25.—Modern tube-cleaning equipment for evaporators, juice heaters and boilers is reviewed, together with its use and care and maintenance.

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Preparing White Sugar for Silo Storage. A. SCHWEITER. *Sugar y Azúcar*, 1957, **52**, (5), 26–27.—The moisture content and temperature requirements for storage of white sugar in silos are discussed and the capabilities of the Büttner turbo-dryer and cooler in this respect are mentioned.

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Factors affecting Quality of Sugar. J. D. TANEJA. *Indian Sugar*. 1957, **7**, 51.—Recommendations for improving sulphitation sugar quality include avoiding cutting of pans and discharging the maximum possible; remelting low-product sugars in the syrup feeding the pans, to increase its purity; keeping a check on final sugar; use of blue in the pans at the time of graining rather than in the centrifugals; keeping a check on the lime salts in juice as an index of clarification efficiency; and avoidance of oversulphitation.

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The Continuous Cane Juice Electro-Clarifier and its Theory, Operation and Economics. D. N. GHOSH. *Indian Sugar*, 1957, **7**, 141–148.—The electrolytic process of cane juice clarification[1] is described. Juice at 75°C passes between alternately-poled electrodes separated by wood distance-pieces at ½ inch gaps. Retention time is 8–10 min, and current density used is 16 amps per sq. ft. Current usage is 23·8 kWh/8250 lb of cane, and the purity rise, after liming to pH 8·5 and neutralising with superphosphate and filtering, is 3·5–4 units.

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Measurement of Stresses in a Modern Cane Mill. E. J. PELLETIER. *Sugar y Azúcar*, 1957, **52**, (7), 23–24. A photoelastic analysis carried out by Squier engineers on a model cane mill under load gave indication of the important points to examine in a stress analysis using strain gauges. A full-scale mill was loaded excessively until it jammed, when the hydraulic load was kept constant, and readings taken of each of 140 strain gauges in important positions on the mill. A dynamic test using the point of maximum stress gave a value little more than twice the load in the static test. A "stress coat" technique was also used, and a six-gauge equipment giving an oscilloscope indication developed to measure mill stresses. By means of this examination it was possible to devise a method of facilitating turn-plate removal without weakening the housing, a feature now incorporated on production mills.

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Automation of Sugar Centrifugals. W. SCHERER. *Sugar y Azúcar*, 1957, **52**, (7), 28–29, 40.—The requirements for automatic control of electric motor drive for centrifugals is discussed, and details given of the time-dependent and speed-time-dependent control systems developed by Siemens-Schuckertwerke A.G.

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Pressures in the Three-Roller Mill. G. H. JENKINS. *Sugar J.* (La.), 1957, **20**, (2), 12–14; 39–40.—Results using the Queensland University experimental cane mill and reported elsewhere are discussed. The pressures between the rollers in a three-roller mill are calculated and plotted in the form of a graph against the distance from the axial plane of the rollers. Total pressure at the back roller is at least 15–20 times that at the front roller with normal settings, hence the resultant roller reaction is practically in line with the centres of the top and back rollers.

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Frothing and Entrainment in Evaporators. P. S. ANANTHANARAYANAN and G. SAHA. *Indian Sugar*, 1957, **7**, 275–276.—Measures to counter frothing and entrainment include increasing the vapour surface and baffle spacing, increasing temperature, and adjusting the thickness of the baffles to the optimum for controlling the size of falling droplets.

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How Taiwan Sugars were Inspected before Shipment. F. T. CHANG. *Taiwan Sugar*, 1957, **4**, (5), 16-12.—An account is given of the inspection of sugar bags with sampling and testing procedures for the sugars contained.

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Sugar Packaging in Taiwan. J. C. HUANG. *Taiwan Sugar*, 1957, **4**, (5), 24–25.—Sugar exported to the Middle East and Africa from Taiwan is packed in jute bags because of consumer preference, and also as a support for the Taiwan jute industry.

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Some Notes on "Inclusion". E. BEESLEY. *S. African Sugar J.*, 1957, **41**, 553–554.—"Inclusions" is the name given to crystals in which sucrose has crystallized over a layer of molasses at some time during growth.

[1] *I.S.J.*, 1957, **59**, 73.

Three forms are illustrated and distinguished, and the occurrence of inclusions in sugar from four Natal factories is discussed. Possible causes are suggested and further work proposed.

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Imbibition Efficiency. B. L. MITTAL. *Indian Sugar*, 1957, **7**, 213–214.—A formula for imbibition efficiency is calculated as $100\left[1-\frac{B}{i}\left(\frac{100}{m}-\frac{P}{P_1}\right)\right]$, where B is bagasse % cane; i = imbibition water % cane; m = juice % bagasse; P_1 = pol of last mill juice; and P_b = pol % bagasse.

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Clarification Studies. Some Effects of Drought on Cane Juice. II. N. O. SCHMIDT, R. STEVENS, L. F. WIGGINS and R. D. E. YEARWOOD. *Proc. B.W.I. Sugar Tech.*, 1955, 79–82.—Experiments as previously described[1] were continued to first ratoons and showed that the duration of drought had approximately the same effect on settling rate of muds from both plant and ratoon cane. Varietal differences occurred. As with plant cane, drought caused an increase in juice constituents, particularly phenolic and nitrogenous compounds, although phosphate and silicate contents decreased. Purity values increased and then remained constant for ratoons compared to plant cane, where a maximum was reached, followed by a decrease in purity. It was concluded that study of plant cane alone will be sufficient to give a guide as to the effect of drought on a particular variety.

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Further Developments in the Use of "Versene" in Evaporator Cleaning. M. C. BENNETT, F. H. CONOLLEY, N. O. SCHMIDT, L. F. WIGGINS and W. S. WISE. *Proc. B.W.I. Sugar Tech.*, 1955, 83–85.—Experiments carried out using EDTA as 5% "Versene" solution for cleaning the third effect of a quadruple were successful. The solution, at pH 6–7, was boiled under vacuum at 70°C for 3 hr, when it was nearly all chelated with scale ions and needed then to be recovered.. This body could not be cleaned in the previous experiments[2] using a pH of 4·5, but at pH 6–7, old scale was removed as well as new. The losses over a 5-week period were less than 2% per week compared with 8% previously, and it is thought that this might be due to less EDTA destruction under the milder conditions. The cost of cleaning is calculated as B.W.I. $1.00 per ton of cane ground per hour.

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Some Observations of Sugar Curing. II. The Effect of the Addition of a Detergent on the Curing of A- and C-Massecuites. N. O. SCHMIDT, R. D. E. YEARWOOD and L. F. WIGGINS. *Proc. B.W.I. Sugar Tech.*, 1955, 91–95.—Addition of "Tween 60" to massecuite has little or no effect on pol, the greatest effect being with *C*-massecuite of 88·0 purity, where addition of 80 ml of detergent per cu. ft. produced only a 1·2 rise in pol. The cost of using "Tween 60" or any similarly-priced detergent is likely to be prohibitive if it is used in sufficient quantity to make any practical difference to the sugar curing process.

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Some Observations on Sugar Curing. III. N. O. SCHMIDT and R. D. E. YEARWOOD. *Proc. B.W.I. Sugar Tech.*, 1955, 95–102.—The rate of acceleration to top speed of a centrifugal containing a *C*-massecuite had no significant effect on final pol and the value of increased acceleration lies, therefore, only in the shortening of the cycle obtained. Increase in pol for any given massecuite temperature difference is greater with lower pol % sugar, using the same cycle. For a given top basket speed there is a limit of pol % sugar obtainable which, in commercial practice, may be reached by curing a suitably re-heated massecuite or by using a sufficiently long cycle time. With increasing top speed, increased pol values were obtained for all temperatures investigated. It was observed that factors which increased the pol of the sugar also tended to harden the sugar and increase the cutting down time. Several treatments were tested for increasing the pol of raw sugar; all caused a rise in pol. There was little difference between washing with water and syrup at the lower levels, but increased quantities of water gave a purer sugar and increased syrup. Mingling unwashed sugar with syrup and re-purging gave a sugar almost comparable with water washing at the higher level; however, there was a considerable loss of sugar, and large additional expenditure would be necessary for this technique. The treatments which obtained the least pol rise were doubling the time at top speed and raising the massecuite temperature by 12°F.

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How the SWC was made Better. S. Y. CHIU. *Taiwan Sugar*, 1957, **4**, (6), 24–26.—Improvement of the quality of SWC (Superior White Crystal) sugar produced at San-Kan-Tan factory is attributed to a number of factors: careful control of middle-juice carbonatation; improvement of first filtration by using a thick cotton cloth and a hemp cloth instead of two cotton cloths, corrugated grooving instead of both vertical and horizontal, and frequent scraping of the grooves; increasing the saturation time in second carbonatation by using a re-circulation pump; low temperature (90°C) in the evaporator first cell; double filtration of syrup; double purging of 1st and 2nd sugars, with remelting of 3rd sugar in thin juice, adding to the syrup which was then sulphited and filtered. The seed sugar powder was sieved, giving a more even final crystal. Steam consumption was increased by 20% but it is hoped to compensate for this by using vapour bleeding. Efforts to eliminate dark particles by cleaning pipelines, etc., have not been completely successful.

[1] *I.S.J.*, 1957, **59**, 158.
[2] *I.S.J.*, 1957, **59**, 158.

A New Nomogram for Diffusers and its Practical Application. P. M. SILIN. *Listy Cukr.*, 1957, **73**, 98–102.—The new nomogram gives the relationship between diffusion losses % sugar, draught, and θ, based on the Silin equation $\gamma = Al\theta Z$, where A = constant for the diffuser design, l = length of 100 g cossette in m, θ = temperature factor $\left(\theta = \frac{T}{1000}\right)$ based on the diffuser mean temperature, and Z = diffusion time in min. Examples of the practical application of the nomogram are given. Values of A are given for continuous diffusers, including the Mandryko, R.T., Brüniche-Olsen, B.M.A. tower, and the Olier. Also compared are the values of l (6·5 m for the Brüniche-Olsen, 14 m for the Olier) and the power consumption/100 kg beet. Standards for A and Al are given for battery diffusers.

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130 Days' Production Without Stoppages for Scale Removal. V. N. TRET'YAKOV. *Sakhar. Prom.*, 1957, (5), 29–30.—Satisfactory continuous operation of the evaporators at Karabulak factory during 130 days was attributed to: a juice alkalinity maintained at 0·08–0·10% CaO during first carbonatation and at 0·03–0·35% during second carbonatation (which dissolved scale formed during periods when optimal alkalinity was not maintained); passing first carbonatation juice carefully through mechanical filters after the filter presses; and to maintenance of the second carbonatation juice at a temperature of 102–103°C. It is pointed out that optimal limits of alkalinity may differ for various beet growing areas of the U.S.S.R.

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Economical Effect of Correct Beet Storage. A. SWIECICKI. *Gaz. Cukr.*, 1957, **59**, 115–117.—The storage of beet in large piles at the reception point or in the factory is discussed with relation to Polish experience. The losses in stored beet during the three campaigns up to and including 1955/56 were estimated as 0·05, 0·03 and 0·022% respectively, the last two resulting from "rational" storage.

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A Second Campaign with Szarejko Filters. W. GÓRALCZYK. *Gaz. Cukr.*, 1957, **59**, 123–125.—The performance of the Ketrzyn filter press station during the 1955/56 campaign is discussed. This comprises seven Szarejko filter presses, four for first carbonatation (plus one reserve) and two for second carbonatation. First carbonatation juice at 65°C was filtered in 3-hour stretches, the throughput being 7 litres/sq. m./min during the first hour at 2 atm pressure, 5 at 3 atm, and 3·5 at 4 atm. Filter cake washings were returned to the juice, or returned for liming if of less than 5°Bx. Average losses were 0·13% on beet.

Determination of the Maximum Juice Draw-off in Rotary Diffusers. V. N. SHCHEGOLEV. *Sakhar. Prom.*, 1957, (6), 13–17.—The formula[1] of E. T. KOVAL' for double-helix rotary diffuser output is corrected for juice lost by adhering to the cossettes and so being transferred from one chamber to the next, and thus leading to mixing of juices of different concentrations. It becomes $q = \frac{\gamma V}{P + 0{\cdot}6}$ where q = amount of cossettes in tons entering the diffuser during one revolution, γ = average density of juice-cossette mixture, V = volume occupied by this mixture in the lower chamber, and P = draw-off expressed as % total juice in the lower chamber when this is filled with juice-cossette mixture. A nomogram for double-helix diffusers of 4·8 m dia. based on the formula is given for determination of maximum juice draw-off as a function of the amount of cossettes entering during one drum revolution, i.e., as a function of slicer throughput. For single-helix diffusers P is replaced by $0{\cdot}5P$.

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Increasing Beet Slicer Efficiency. Z. D. FEL'DSHON. *Sakhar. Prom.*, 1957, (6), 22–23.—Improvements in beet slicers are discussed and the need for a cutting speed in the range of 8–16 m/sec for centrifugal slicers emphasized.

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Experiment in Beet Storage at Zemetchinsk Sugar Factory. M. I. DRUZHININA. *Sakhar. Prom.*, 1957, (6), 23–24.—Beet stored in two 4 m high covered piles for 111 and 126 days showed sugar losses of 0·539 and 0·516% by wt. on beet, respectively, whereas beet stored in piles 2·5 m high sustained losses of 0·573 and 0·756% by wt. on beet over 104 and 122 days respectively. For storage piles 4 m high it is necessary to have at least three stackers and one "coverer" at the reception point.

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Mechanical Beet Unloading from Trucks. A. M. PUKLICH. *Sakhar. Prom.*, 1957, (6), 25–28.—A metal grid mounted on a frame placed across the truck immediately behind the cabin has two cables attached, one to each end, which meet at a ring at the drop-board. To unload the beet, a cable from the back of a tractor is hooked on to the ring and the frame is pulled along the floor of the truck, pushing the beet off the truck.

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Operation of a Sprinkler-Type Sulphitation Tower. E. I. OBUSHINSKII. *Sakhar. Prom.*, 1957, (6), 32–33. A description is given, with a diagram, of the sulphitation tower used by one group of Russian factories.

[1] *I.S.J.*, 1958, **60**, 22.

Continuous Feeding of Cossettes into a Rotary Diffuser. I. B. ZINGEL' and YU. M. POLYAKOV. *Sakhar. Prom.*, 1957, (6), 33–34.—Modification of cossette feeding to the rotary diffuser at Krasnyansk factory included elimination of the rake conveyor and automatic scales between slicers and diffuser and installation of the scalder immediately beneath the slicers. The quality of the cossettes improved as they were no longer bruised on the conveyor and scales, and the number of stoppages was greatly reduced. A saving of more than 12 kW was made possible by the elimination of three electric motors, viz., those powering the conveyor, automatic scales, and diffuser feed mechanism. An automatic locking gear for the slicers was installed and controlled from the diffuser control panels making it possible to stop one of the two slicers when there was danger of overloading of the diffuser due to stoppages in the feed line.

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Steam Consumption of Continuous Diffusers. L. I. SHAPIRO. *Sakhar. Prom.*, 1957, (6), 49–50.—The argument that the steam requirements of a continuous diffuser are greater than those of a diffusion battery is refuted and calculations are given to support the author's view that the consumption is about the same. For a continuous diffuser it is found to be 16·8% by weight of beet, or 13·6% if ammoniacal water at 70° is used, while the consumption of a diffusion battery is given as 17%.

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Theory of (Juice Flow) Calculation for Columns Filled with Material Undergoing Deformation (Cossettes). S. M. GREBENYUK. *Sakhar. Prom.*, 1957, (6), 55–61. The following formula for liquid (juice) flow rate in a column filled with liquid and material being deformed (cossettes) of negligible density difference was developed by the Hungarian Sugar Research Institute:

$$w^n = \frac{1}{k \cdot a \cdot h_o \cdot q_o} \cdot \phi(P_o)$$

where w = juice flow rate, n = empirical exponent, k (empirical) = fluid resistance, a (empirical) = compressibility of the material, h_o = initial length of column, q_o = specific cossette load (proportion of cross-section occupied by cossettes) when the pressure drop along the column = 0, ϕ = exponential function of q_o, P_o, and n, and P_o = pressure drop. Experimental results, in good agreement with the theoretical, show that charging the diffuser with cossettes simultaneously with liquid reduces specific loading of the cossettes and gives a higher juice flow rate than the usual charging method. The column of cossettes cannot be divided into hydrodynamically independent individual sections by means of suspended chains. Percolation of the juice through the column is possible without hydrodynamic equilibrium, in which case the value of q_o is small and w is considerably greater for a given pressure than under equilibrium conditions.

Effect of the Composition of the Water supplied to the Sugar Factory on the Technological Production Processes. P. M. SILIN. *Sakhar. Prom.*, 1957, (7), 15–16.—The lack of information in the literature on the effects of different types and degrees of water hardness on the factory processes is deplored. The author calculates that about three-quarters of the salts in the diffusion water pass into juice, the remainder leaving as scum. Scaling in the evaporators caused by the presence of magnesium salts can be overcome by maintaining high alkalinity in first carbonatation, i.e., 0·09–0·10%. Although bicarbonates in the water do not harm the evaporators, they can cause considerable scaling in the vacuum-pan condenser, tubes, and barometric water pipe, and in the diffusion water pipe. Permanent hardness caused by soluble calcium salts is not harmful in this respect, but causes increased sugar losses in molasses.

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Beet Sugar Factories with Refinery Sections. I. F. ZELIKMAN. *Sakhar. Prom.*, 1957, (7), 17–20.—Average purities of thick syrup after the evaporator station from nine beet factories with refinery sections are tabulated for five campaigns. It is shown that the raw sugar and refined sugar processes should be independent of each other, the extra equipment required for the refined sugar end being justified by continuous use throughout the year. A two-boiling system for the beet factory and a three-massecuite system for the refinery are advocated. A slight increase (4–4·5%) in the number of boilings in the refinery would be balanced by a decrease of 12–20% in the beet factory in some factories. A reduction is recommended in the amount and purity of green syrup from refinery second massecuite sent to the beet factory.

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Factors Affecting Odour in Beet Sugar. E. H. HUNGERFORD. *J. Amer. Soc. Sugar Beet Tech.*, 1957, **9**, 377–380.—An account is given of an inconclusive survey made to determine the cause and methods of elimination of odour in beet sugar.

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Rain-am-Lech Factory, Süddeutsche Zucker A. G. *Paper presented to the 10th Tech. Conf. British Sugar Corp.*, 1957.—A detailed description is given of the new Rain factory which was built last year. It is of 3000 tons/day slicing capacity and receives 80% of its beets by rail and the rest by road. Storage space is sufficient for 40,000 tons of beet and is provided with ventilation channels. Beets are flumed to a 30-ft dia. beet wheel which lifts them to the washer from which they pass to the slicers along a rubber conveyor belt. Dirty water is recirculated via a 155 ft dia. settling pond. The four slicers feed cossettes to two 1700-ton Buckau R. Wolf tower diffusers, preceded by the standard scalding troughs. Pulp press water is returned, and fresh water intake controlled automatically. The Sepa process, in which mud precipitated at pH 10·8 is separated, mixed with

molasses and added to pressed pulp and dried, is used. This mud is obtained in saturation plant Ia after preliming ; the remaining equipment includes saturation plants Ib and II, the first operating at pH 10·8 and the second at optimal precipitation with milk of lime addition if required. Mud from the 3 first carbonatation decanters is thickened in 8 De Laval separators and passed to 4 rotary filters, while second carbonatation mud is separated by one decanter and two rotary filters. Juice is passed through ceramic pressure filters. The quadruple effect evaporator has a total heating surface of 66,600 sq. ft. and two vessels each form the 2nd and 3rd effects. Steam entering the first body is at 22–24 p.s.i., and the temperature in the last is around 95°C. Thick juice Brix is at least 65°. A three-boiling system is employed, the low-grade product being washed and remelted to use in the medium product. Part of the first product is sold as white sugar while the remainder is remelted with the washed medium product and reboiled as refined sugar. All except the low-product are separated in 950 or 1000 r.p.m. step cone centrifugals, the low product being spun in 1500 r.p.m. flat-bottomed machines. Two drum dryer-coolers are used. Three cylindrical refined and white sugar silos of pre-stressed concrete will hold 26,000—28,000 tons each.

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The New Limekiln and Lime Cream Plant at Ipswich and its Automatic Control. T. LANGHAN. *Paper presented to the* 10*th Tech. Conf., British Sugar Corp.*, 1957.—Coke and limestone in separate hoppers are transferred into a skip by way of a weigher which charges pre-determined weights of each. Ten skip-loads are brought up a conveyor and tipped into the top of the lime kiln when the burden level falls by a pre-determined level as indicated by a probe. The discharge from the kiln is governed by a max.-min. level control on the raw milk-of-lime tank.

Sweet water is adjusted to constant density with condensate under the action of a Rotameter control, and this is used to supply the lime slaker and to adjust the density of the raw milk of lime. The milk of lime circulates between the factory supply tank and the raw tank and a bypass from the former leads to a second Rotameter instrument for controlling sweet-water addition to bring to constant density. When the level falls to the minimum in the raw milk of lime tank, a series of relays of the slaker, burnt lime conveyor and kiln unloaders are energised in that order, while an air-operated valve opens to allow sweet water to enter the slaker at a pre-set rate. Details are given of the units and controls, and of modifications to overcome teething troubles in the first week of operation.

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Pulp Drying and its Automatic Control. R. M. J. WITHERS. *Paper presented to the* 10*th Tech. Conf., British Sugar Corp.*, 1957.—The principles of the general dryer control scheme as used in the British Sugar Corporation factories are discussed and the variations described in detail. Basically, the temperature of the exhaust gases at the eye to, or just after, the induced draught fan, is measured by means of a gas thermometer with the bare stainless steel bulb. The pneumatic indication is converted by one means or another into an electrical control of the speed of the motor driving the conveyor which feeds molasses-mixed pulp to the dryer. The response of the control system to changes in set-point temperature and the effect of other disturbances—nonuniformity in the drying process ; changes in furnace conditions and molasses addition—are described. The automatic control is capable of maintaining the outlet temperature to the order of 1°C accuracy instead of the usual 7°C with manual control. Conditions have been improved for the operator but automatic control has not produced any demonstrable significant improvement in efficiency.

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Juice Purification Method Suitable for Continuous Mud Separation. K. VUKOV. *Cukoripar*, 1957, **10**, 27–38 ; through *S.I.A.*, 1957, **19**, Abs. 422.—The raw juice is treated with not less than 40% (by vol.) of unfiltered first carbonatation juice, at 85°C, and is then progressively pre-limed for 5 min ; this is followed by the usual main liming (in 5 min) and carbonatation. The saturated juice passes through a thickener in 1 hr, and is then filtered on a rotary vacuum filter. The theory of the different steps of the process is discussed, and methods of analytical and other controls are described. Hot predefecation was found best. The increase in colour during carbonatation was less than 15%. Filtration speed was 19 litres/sq.m./min. The muds could be sweetened off with 87% water to 0·94% sugar content ; 98·2% of the muds were separated. Total lime consumption was 1·3—1·5% CaO on beets. The process was not affected by variations in the quality of the raw material.

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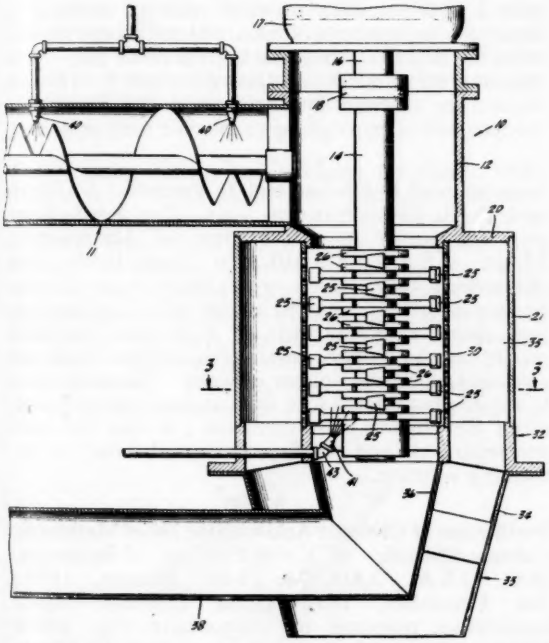
Sand and Stone Removal from Beets. V. N. PELETMINSKII. *Sakhar. Prom.*, 1957, (7), 27–30.—RETTINGER's formula for the determination of the settling rate of foreign bodies in beet wash water is : $v = 0{\cdot}25\sqrt{(\gamma_1-\gamma_2)d}$, where γ_1 = S.G. of foreign body particles (g/c.c.), γ_2 = S.G. of water, and d = equivalent diameter of particles (dia. of spheres having the same volume). A water flow rate greater than 0·2 m/sec is necessary to ensure suspension of the beet while particles of greater density sink. A diagram shows dependence of the floating tendency of the particles on the water flow rate. The materials discussed include iron, quartz sand, gravel, anthracite, brick, and slag. A stone and sand trap system after the trash catcher is described and illustrated.

UNITED STATES

Separation of Bagasse Pith and Fibre. J. H. PAYNE, W. KENDA and H. I. MAHON, assrs. HAWAIIAN DEVELOPMENT COMPANY LTD., of Honolulu, Hawaii, **2,805,156.** 21st January 1953 ; 3rd September, 1957.—Bagasse is cooked in an aqueous medium, e.g. 3–6% caustic soda, for at least 30 minutes (1 hr) at a temperature above 150°F (190–200°F), using 0·5–6% caustic soda by dry weight of bagasse. Sufficient water is added to bring the consistency down to less than 2% and the resulting mixture of softened bagasse fibres, bagasse pith and foreign matter is introduced by conveyor 11 into disintegrator 10.



It falls on to the swing hammers 25, which are driven by motor shaft 16 via coupling 18, within the cylindrical screen 30. Dirt and pith, already partially separated from the fibre by the action of water sprays 40 within conveyor 11, are further separated by the action of the hammers 25 and further water sprays 41. Dirt and pith pass through the perforations in the screen 30, are collected by the annular chamber 35 and pass out of the machine, while the fibre is retained by the screen, falls into the chamber formed by section 36 and passes out of the machine by way of conduit 38.

Beet Lifter and Topper. S. A. ANDERSEN, of Stenstrup, Denmark. **2,806,540.** 15th August, 1956 ; 17th September, 1957.

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Cube Sugar Process and Product. H. J. STEINER, of New York, N.Y., U.S.A. **2,807,559.** 29th December, 1954 ; 24th September, 1957.—About 84–98% (92%) by weight of sucrose is mixed with 2–16% (8%) of a dry molten binder, and the mixture formed into shape, compressed if required, and cooled. The binder may preferably be sorbitol, or otherwise dextrose, gluconolactone, mannitol, xylose, fructose, arabinose, mannose, maltose, raffinose, sorbose or arabonic acid.

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Processing of Sugar Beets. L. E. BROWNELL and S. A. ZIEMINSKI, assrs. U.S. SECRETARY OF AGRICULTURE. **2,807,560.** 14th October, 1953 ; 24th September, 1957.—Cut beets are preheated with steam at atmospheric pressure for 1–6 minutes and then with a sudden burst of high-pressure steam or compressed air or a mixture of these, at a pressure of at least 40 p.s.i.g., for a period of 2 seconds to 6 minutes at a temperature of 200–300°F. This is followed by a sudden release of pressure to discharge the beets explosively into a second zone maintained at a pressure no higher than atmospheric, so that the beets impinge on a barrier and are disintegrated. Sugar-containing juice is then recovered from the resulting mass.

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Sugar Cane Segmentizing Apparatus (Cane Sett Cutter/Harvester). R. A. DUNCAN and D. M. BURNS, assrs. HAWAIIAN DEVELOPMENT CO. LTD., of Honolulu, Hawaii. **2,808,865.** 12th July, 1956 ; 8th October, 1957.

* * *

Recovery of Amino-Acids (Glutamic Acid and Pyrollidone Carboxylic Acid). M. J. BLISH and A. J. SCHLAEGER, of Chicago, Ill., assrs. INTERNATIONAL MINERALS & CHEMICAL CORP. **2,809,212.** 23rd September, 1952 ; 8th October, 1957.—Residual glutamic acid from a Steffen's filtrate end-liquor, after extraction of the bulk of the glutamic acid, is used to enrich a further sample of filtrate. The residual liquor, adjusted to pH 2–4, is passed over acid-activated alumina, of 28–48 mesh, whereby the acids are adsorbed. The fresh filtrate, of 25–50% solids and pH greater than 9·5, is used to elute the acids. It may then be hydrolysed to convert the pyrollidone carboxylic acid to glutamic acid and this recovered, or adjusted to pH >9·5 and re-used to elute further glutamic acid values from alumina.

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 2s each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

Cane Harvester. Y. OYAMA, of Wailuku, Hawaii. **2,809,487.** 21st October, 1955 ; 15th October, 1957.

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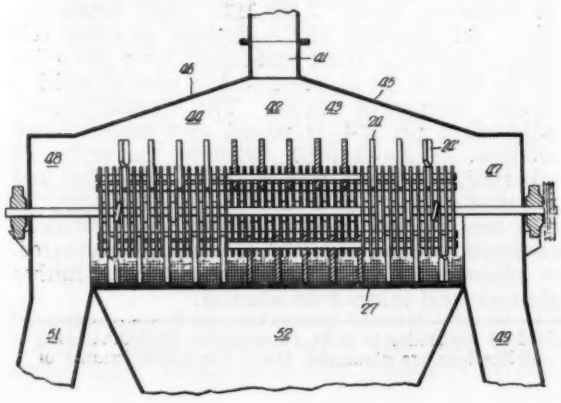
Converting Sugar (into Liquid Sugar). F. N. RAWLINGS, J. H. GRANTHAM and C. C. MILLER, assrs. THE AMALGAMATED SUGAR CO., of Ogden, Utah, U.S.A. **2,809,903,** 21st May, 1956 ; 15th October, 1957.—A converter assembly receives granulated sugar falling into it under gravity and is provided with an inlet and an outlet conduit whereby water under pressure is pumped into the converter, and mixes with the sugar before passage into the exit conduit through which it is drawn by an evacuating pump, of greater capacity than the first water supply pump. The evacuating pump feeds a tank from which water is drawn by the supply pump. At the point of contact with the sugar, the water stream is in the form of a flat ribbon. Some of the sugar is dissolved in the converter chamber and the remainder in the tank.

* * *

Fibre from Bagasse. T. R. MCELHINNEY, assr. VALITE CORP., of New Orleans, La., U.S.A. **2,810,647.** 21st December, 1954 ; 22nd October, 1957.—Bagasse is treated with sufficient milk of lime to give a pH of 7·5–9 and digested at 239–338°F (295°F) until 3–25% of lime by weight of bagasse (3–8%, 4·5%) has been consumed (3 hr). Digestion is then continued at 239–338°F (240°F), adding sodium hydroxide to give a concentration not greater than 0·1% (not greater than 0·06%) until 4–25% (7·5–25%, 7·33%) has been added. After 7·5% of NaOH has been added the concentration may be adjusted to not greater than 0·2% (not greater than 0·06%) by increased addition until 25% has been consumed, whereafter a further single addition may be made at one time and the pulping process continued.

* * *

Separation of (Bagasse) Pith and Fibre. P. M. HORTON and A. G. KELLER, of Baton Rouge, La., U.S.A., assrs. BOARD OF SUPERVISORS OF LOUISIANA STATE UNIVERSITY AND AGRICULTURAL AND MECHANICAL COLLEGE. **2,812,552.**—Two types of hammer mills are described, the first basically similar to that patented earlier[1] except that no paddles are provided, and the top of the casing is so shaped that the bagasse enters a large free space above the hammers, which space is decreased along the axis of the machine, so that the bagasse is forced into contact with the disintegration hammers. The second form of the mill is provided with a central entry port for bagasse which passes toward both ends, and is forced into contact with the hammers by the decreasing space under covers 45, 46. The fibre is carried over into chambers 49, 51, while the hammers 24 separate pith which passes downwards and out through the perforated bottom 27 into chamber 52.



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Treatment of Vinasses Containing Pyrollidone Carboxylic Acid. A. M. ZENZES, of New York, N.Y., U.S.A. **2,813,103.** 13th April, 1954 ; 12th November, 1957.—Vinasse from beet molasses is acidified to pH 1·5—3·5 with sulphuric acid and sufficient methanol and/or ethanol added to precipitate alkali metal salts. These are separated and the solution contacted with a hydrous silica material such as vermiculite, bentonite, or montmorillonite, which adsorbs betaine from the solution ; this can be recovered later. The betaine-free solution is adjusted to pH 9—12 with barium or calcium hydroxide and the barium or calcium salt of pyrollidone carboxylic acid separated.

* * *

Separation of D–Glucose and D–Fructose. F. SMITH and D. R. SPRIESTERBACH, assrs. THE REGENTS OF THE UNIVERSITY OF MINNESOTA, of Minneapolis, MINN., U.S.A. **2,813,810.** 1st June, 1954 ; 19th November, 1957.—Sucrose or invert sugar is suspended with 1–1½ parts by weight of a sulphonated-type cation exchange resin in 5–15 times the total weight of sugar plus resin of a ketone (acetone) containing 2–8% by volume of water. The suspension is stirred gently for 2 to 6 days at room temperature, when the glucose crystallizes out ; it and the resin are separated, and fructose recovered from the remaining solution.

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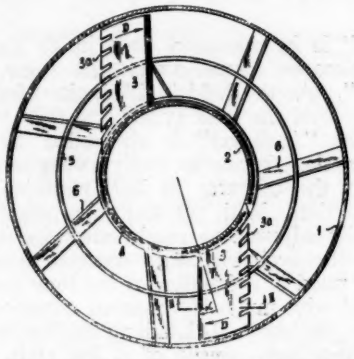
Purification of Glutamic Acid with the aid of Methanolic Calcium Chloride. E. V. MCCOLLUM, of Baltimore, Md., U.S.A., **2,815,374.** 14th January, 1957 ; 3rd December, 1957.—Dried Steffen's liquor hydrolysate prepared by evaporation (e.g. below 100°C to prevent decomposition) or Steffen's filtrate with up to 35% water content is treated with sufficient methanol to give a solution containing less than 5% of water. The solution is made alkaline by adding ammonia in methanol, and insolubles filtered off. Glutamic acid is then precipitated by addition of a solution of anhydrous calcium chloride in methanol.

* * *

(Beet) Diffusion Apparatus. K. HEINRICH, of Grevenbroich, Germany. **2,816,049.** 27th June, 1955 ; 10th December, 1957.—The central rotating shaft 2 of a tower diffuser is surrounded by a number of stationary annular walls 4, mounted one above the other up the tower, and held in place by arms 6

[1] U.S.P. 2,729,856—8 ; *I.S.J.*, 1957, **59**, 134.

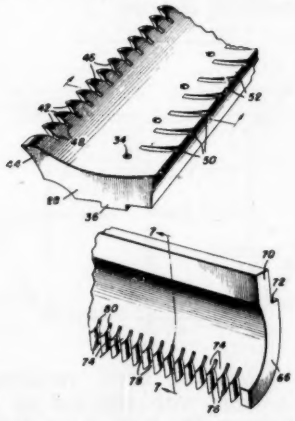
fastened from the inside wall of the diffuser tank which are also connected by annular members 5. Arms 3 attached to the rotating shaft 2 travel round in the intervals between the walls 4 and are of a type of aerofoil shape and inclined downwardly so that



they cause cossettes to be directed upwards through the tower. The arms 3 are staggered at an angle down the shaft, so providing channels for diffusion liquid to pass to the bottom of the tower and producing efficient mixing and extraction.

* * *

Self-Draining Knives and Scrapers for Sugar Mills. L. BARRETO, of Havana, Cuba. **2,818,013.** 1st May 1952 ; 31st December, 1957.—The turnplate 28 of a three-roller mill is bolted to the turn plate beam through sockets 34. The edge which is nearest the feed roller is provided with a number of teeth 42 which provide spaces 46 for the grooving of the feed roller so that the turnplate can be held closely to but not in contact with the feed roller, preventing cane from falling through. The gaps 46 are extended as grooves 48 which permit drainage of juice from the material



leaving the feed roller. The other edge of the turnplate is also provided with drainage channels 50 opposite the nearest points of the discharge roller grooving which permit further drainage of juice expressed by the compression of the cane passing between the top and discharge rollers.

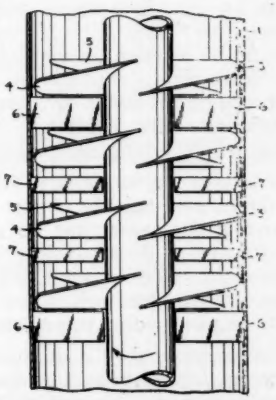
Scrapers are also provided for the top and discharge rollers, mounted on beams across the rear end of the mill. They are provided with teeth 74 which correspond to the grooving on the rollers, together with grooves 80. Thus the scrapers are able to keep the top and discharge rollers clean without causing wear, and also allow drainage of the juice expressed.

* * *

Treatment of Sugar Beets to Release Juice. L. E. BROWNELL and S. A. ZIEMINSKI, assrs. U.S. SECRETARY OF AGRICULTURE. **2,818,358.** 17th December, 1954 ; 31st December, 1957.—A stream of steam is established, moving in a confined linear path at a velocity of at least 200 f.p.s. Raw unheated sugar beet pieces are fed at a predetermined rate into the stream and thereby accelerated to a velocity approaching that of the stream. Time of contact between the steam and the beet is less than one second, after which the stream is directed so that it impinges on a barrier, from which the resultant beet pulp is removed and its juice content separated.

* * *

Counter-Current (Beet) Diffusion Tower. W. KATHER of Braunschweig, Germany, assr. BRAUNSCHWEIGISCHE MASCHINENBAUANSTALT and PFEIFER & LANGEN. **2,819,190.** 18th March, 1953 ; 7th January, 1958.—A tower diffuser 1 is fitted with an interrupted screw conveyor comprising vanes 3,4 and 5. In conventional towers, positive action of the conveyor is ensured by means of interruptor plates 6 which fill the gap between successive groups of vanes. This arrange-



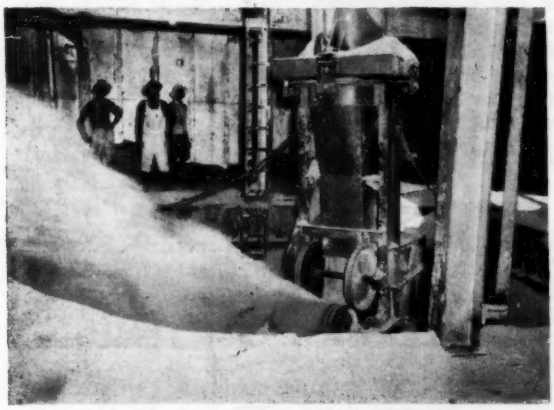
ment sometimes leads to clogging of cossettes and consequent stoppages; by making the plate smaller than the gap, as at 7, flow around the plates is permitted while retaining the upward directing action of the plates. The free space required depends on the size of the cossettes, and the plates 7 are therefore mounted on pivots through the wall of the diffuser so that they can be rotated and thereby present a varying interruptor height in the gap between groups of vanes.

TRADE NOTICES

Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.

Bulk Handling in Puerto Rico. Link-Belt Company, Prudential Plaza, Chicago 1, Ill., U.S.A.

Sugar Service Corporation, an operating company owned by Central San Vincente, Fajardo Sugar Co., Eastern Sugar Associates and Bull Insular Lines, was faced with handling raw sugar from road trucks to dockside warehouse storage and then re-handling it from storage to ship's hold for export.



The Corporation was also faced with an initial franchise (to run for only five years) to operate pier facilities designated as "Shed A". No extension on the franchise could be counted on beyond five years, so that it was desirable to provide an installation that would amortize itself within five years or less, and provide efficient bulk handling without the expense of permanent handling equipment.

Emphasis was laid on equipment that would handle bulk shipments quickly from the hard-pressed store and at the same time be versatile in either direct-to-storage or direct-to-ship re-handling. Link-Belt designed the system around belt conveyors and four compact "Jetslingers" which are used both in the warehouse and in loading ocean vessels.

"Jetslingers" are composed of a short endless belt operated over two pulley drives at high speeds. Idler wheels form the conveying arc and the trajectory angle—which can be adjusted by raising or lowering the front pulley. A chute above the "Jetslinger" directs bulk material on to the rear slope of the belt as it travels around the short conveying arc at high speeds, discharging the material by centrifugal force.

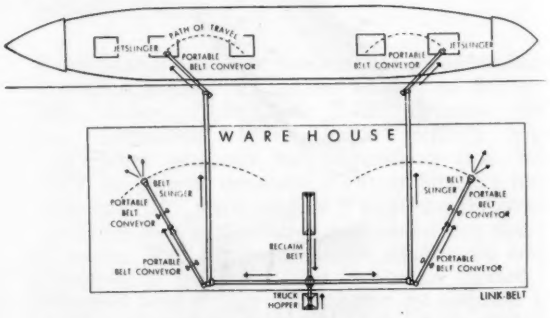
Two of the "Jetslingers" are used within the warehouse to "sling" sugar into storage piles, permitting full use of limited space. Two other units are used in loading ocean-going vessels by directing the flow of raw sugar to all areas of the hold. When the "Jetslinger" is in operation deep inside the ship's hold, a telescopic chute directs the sugar to the "Jetslinger". As the hold is filled, the "Jetslinger" is raised to trim the load evenly.

Since the "Jetslinger" is suspended by cables during operation, it can be easily swung around or steadied by the operator to hurl material in any desired direction. With the trajectory angle of the stream easily adjusted to reach otherwise inaccessible areas, the available cargo space is evenly and completely filled in a fraction of the time ordinarily needed, and with much less manual attention.

Basically, the materials handling facilities at Sugar Service Corporation consist of a 200 t.p.h. system from truck hopper to storage or directly to ship-loading; and a 200–400 t.p.h. reclaim system from storage to ship-loading.

The versatility of the system is illustrated by the following combinations of operations: (*a*) with outside truck deliveries coming in at approximately 200 t.h.p. an additional 200 tons can be reclaimed from warehouse storage, making a total of 400 t.p.h. that can be loaded into waiting ships; (*b*) with truck deliveries seasonally delayed, the entire 400 t.p.h. can be loaded from warehouse storage to ship's hold.

To suit these changing patterns, two inclined ship-loading boom conveyors are so designed that either of them, using a "Jetslinger", can handle the 400 t.p.h. Either of them can also split the handling load in several patterns. Each boom conveyor can be made to load 200 t.p.h. or various combinations such as 100 and 300 t.p.h. depending on what the ship-loading operation dictates.



Within the warehouse itself, reclaiming from storage piles is done with the aid of front-end loaders. These dump the bulk sugar directly to a centrally located hopper. The same portable conveyors that are used with the "Jetslingers" for distributing the sugar into storage can also be used to reduce the amount of travel necessary within the warehouse when reclamation is being made from extreme ends of the building.

BREVITIES

Polish Factory for Iran.[1]—An agreement has been signed in Teheran under which Poland is to deliver a complete sugar factory to Iran, the cost of which will be about $3,200,000.

* * *

Egyptian Delegation in Russia.[2]—An Egyptian delegation should shortly be in the U.S.S.R. to study Russian sugar factory operation. Plans have been made for growing beet in two areas in Egypt, and factories will apparently be delivered from Russia under the credit agreement with Egypt.

* * *

Large Hawaiian Boiler.[3]—A new boiler, claimed to be the world's largest bagasse-fired unit, is undergoing final tests at the Paia mill of Hawaiian Commercial & Sugar Co. It will replace several old boilers and has a rated capacity of 200,000 lb of steam per hour at 425 p.s.i. and 700°F. Its cost is about $1,240,000. It was manufactured by the Riley Stoker Corporatian.

* * *

Guadeloupe Production, 1956/57.[4]—Sugar output in 1956/57 reached 117,523 tons as against 129,914 tons the previous year. The total cane crushed amounted to 1,204,224 tons compared with 1,451,718 tons in 1956, corresponding recoveries being 9·76% and 8·95% respectively. The lower production in 1956/57 was due to hurricane damage, and 1957/58 production is forecast at about 130,000 tons.

* * *

The Late P. V. Tippet.—Philip V. Tippet, who had a long engineering career with Farrel-Birmingham Co. Inc. died suddenly on February 25th, 1958. Mr. Tippet was born in Birkenhead, England, and went to Ansonia in 1901, joining Farrel the following year. He was granted a number of patents for sugar mill machinery and was the author of several papers on cane milling. He retired in 1952.

* * *

British West Indies Sugar Production and Consumption.—The British West Indies Sugar Association released the following data on 24th March 1958 :

CROP RESULTS AND FORECASTS :

	1956	*Production* 1957	*Estimate* 1958
Antigua	28,478	31,670	25,000
Barbados*.....	151,171	204,525	175,000
British Guiana ..	263,333	284,973	295,000
Jamaica	362,390	370,975	394,750
St. Kitts.....	49,850	44,376	42,000
St. Lucia	10,874	9,314	9,120
Trinidad	160,230	167,805	177,900
	1,026,326	1,113,638	1,118,770
St. Vincent	3,938	3,557	4,000
	1,030,264	1,117,195	1,122,770

LOCAL AND NEIGHBOURING CONSUMPTION :

	1957	Estimate 1958	Available Export 1958
Antigua	1,598	2,000	23,000
Barbados*.....	10,035	10,500	167,724†
British Guiana ..	18,612	18,250	283,918†
Jamaica	57,387	62,000	339,007†
St. Kitts	2,286	4,500	37,500
St. Lucia	1,750	1,920	7,200
Trinidad	25,993	30,000	147,900
	117,661	129,170	1,006,249
St. Vincent	2,751	2,600	1,400
	120,412	131,770	1,007,649

* Production and export figures include Fancy molasses.
† Includes stock at end of 1957.

Martinique Production 1956/57.[5]—In the 1956/57 campaign 69,695 tons of sugar were produced from 761,041 tons of cane, the previous year's figures being 86,339 and 1,122,424 tons respectively. The rate of recovery was 9·16% compared with 7·69% the previous year. The low production in 1956/57 was due to internal warfare at the beginning of the previous season. For 1957/58, however, output is expected to reach 90,000 tons.

* * *

South African Crop, 1957/58.[6]—The 1957/58 season finally came to a close on 18th March with the closing of the last mill, according to the South African Sugar Association. The final outturn of 959,872 short tons (857,029 long tons) represents an increase of 111,227 short tons over the previous season's production and 20,892 tons over the record set up in 1955/56.

* * *

Bulk Shipping Facilities in Puerto Rico.[7]—Warehouses and equipment for shipping sugar in bulk through the port of Aguadilla will be ready for use in the 1958 crop. This port, situated in the north-eastern region of Puerto Rico, will serve nine centrals which produce about 300,000 tons of sugar per year, and it is estimated that 80% of this sugar will be shipped in bulk. The installation was built at a cost of about $1,500,000. Its capacity is 700 tons of sugar per hour which will be one fourth of Puerto Rico's production.

* * *

Eire Imports.[8]—Imports of raw sugar into Eire during 1957 decreased to 45,329 tons from the 1956 figure of 65,482 tons in 1956. No sugar was imported from Brazil and Peru, which in 1956 contributed 29,706 and 935 tons, respectively, while the Cuban supplies dropped from 34,841 tons in 1956 to 9,600 tons in 1957. Dominican Republic, on the other hand, supplied 35,729 tons in 1957 against none in 1956. Only one ton of refined sugar was imported in 1957 compared with 100 tons, supplied by the U.K., imported in 1956.

* * *

Cyclone Damage in Mauritius.[9]—Two cyclones passed to the west of Mauritius on the 19th March and the 9th April. Torrential rains caused by the first led to flood damage and the cane suffered from strong gusts of wind. Damage was probably intensified by the second cyclone and recovery of the crop will certainly be delayed. It is too early to assess the overall effect of the two cyclones, but there is very little hope that the crop will be the record one which was anticipated. Current estimates are 532,540 metric tons for 1958 compared with the preliminary compilation of the 1957 crop at 561,598 metric tons.

* * *

Polish Sugar Crop.[10]—The 1957 sugar crop in Poland resulted in a production of 1,060,000 tons, or 60,000 tons more than had been anticipated. The sugar factories received 7,600,000 metric tons of beet and produced 1,010,000 tons of white sugar, 40,000 tons of raw sugar and 10,000 tons of yellow soft sugar. After providing for the requirements of the Polish population and industry, there will be about 230,000 tons of sugar available for export. Arrangements are already being made to contract for sugar beets for 1958. The growers are to receive a higher return for that year and the Government hopes that this will result in a further increase in sugar production.

[1] *Hautes Etudes Economiques*, 2nd April, 1958.
[2] *Zeitsch. Zuckerind.*, 1958, **83**, 134.
[3] *Sugar News* (Hawaii), 1958, **8**, (2), 4.
[4] F. O. LICHT, *International Sugar Rpt.*, 1958, **90**, (Supp.6), 9.
[5] F. O. LICHT, *International Sugar Report*, 1958, **90**, (Supp.6), 9.
[6] C. Czarnikow Ltd., *Sugar Review*, 1958, (349), 69.
[7] *Sugar y Azúcar*, 1958, **53**, (2), 40–41.
[8] C. Czarnikow Ltd., *Sugar Review*, 1958, (349), 68.
[9] *Mauritius Sugar News Bull.*, 1958, (78).
[10] *Economische Voorlichting*, 21st February, 1958.

BREVITIES

New Jugoslav Factory.[1]—A new sugar factory is to be erected at Ludbreg near Varasdin in one of the centres of Jugoslavia sugar beet growing.

* * *

Burma Sugar Situation.[2]—It is expected that Burma will be self-sufficient in sugar within a year or so. Four mills, two at Zeyawaddy and one each at Pyinmana and Namti are now producing 40,000 tons annually against a domestic requirement of 50,000 tons.

* * *

Cuba—Sweden Trade Agreement.[3]—Under the terms of a trade agreement signed in Havana recently, Sweden undertakes to accord all necessary facilities, including the issuing of licence for the import of 75,000 metric tons of Cuban raw sugar during the three years commencing 27th December 1957, with not less than 20,000 tons each year.

* * *

British Guiana Record Production.[4]—Sugar production for the year 1957 reached a record of 284,973 tons. The year's grinding operations came to a close on 20th December. The record for weekly production was also broken ; production for the week ended 5th October 1957 was 10,988 tons—46 tons more than the previous record set during the week ended 1st September, 1956.

Stock Exchange Quotations

CLOSING MIDDLE

London Stocks (*at 18th April* 1958)	
Anglo-Ceylon (5s)	11/7½
Antigua Sugar Factory (£1)	21/–
Booker Bros. (10s)	19/6
British Sugar Corp. (Ltd. (£1)	14/3
Caroni Ord. (2s)	4/–
Caroni 6% Cum. Pref. (£1)	17/9
Distillers Co. Ltd. (6s. 8d units)	22/7½
Gledhow Chaka's Kraal (£1)	55/–
Hulett & Sons (£1)	64/–
Jamaica Sugar Estates Ltd. (5s units)	5/3
Leach's Argentine (10s units)	9/–
Reynolds Bros. (£1)	47/–
St. Kitts (London) Ltd. (£1)	48/9
Ste. Madeleine (Ord.) (£1)	25/9
Sena Sugar Estates (10s)	19/3
Tate & Lyle (£1)	55/9
Tate & Lyle Investments Ltd. (5s)	9/9
Trinidad Sugar (5s stock units)	8/3
United Molasses (10s stock units)	29/–
West Indies Sugar Co. Ltd. (£1)	27/6

CLOSING MIDDLE

New York Stocks (*at 17th April* 1958)	$
American Crystal ($10)	33⅝
Amer. Sugar Ref. Co. ($100)	27⅝
Central Aguirre ($5)	18¾
Cuban American ($10)	20⅝
Great Western Sugar	24⅛
South P.R. Sugar	26½
United Fruit Co.	46
West Indies Sugar Corp. ($1)	54

Czechoslovakia Sugar Crop, 1957.[5]—Production of sugar in 1957 at 792,000 metric tons is higher than had been generally expected, although it was belived that very good results had been achieved. Production for 1956 and 1955 was 593,000 and 656,800 tons, respectively.

* * *

Thailand Sugar Situation.[6]—Plans to capture Thailand from an importer to an exporter seem to be unsuccessful so far. Consumption is at present running in the region of 80,000 tons, while domestic production is about 17,000 tons below this figure. It is now intended that a new refinery should be built, capable of meeting this deficit.

* * *

Paraguay Production 1957/58.[7]—Production up to 7th January, at 29,000 tons, has broken all records. The Government has authorised credits to a total of about £100,000 to the sugar mills for machinery repairs and re-equipment in an effort to raise output next year to 35,000 tons. If this target is achieved the country will need improved storage facilities or better export prospects than are seen at present.

* * *

Portuguese Sugar Imports.[8]—Imports of sugar into Portugal during 1957 totalled 136,899 metric tons, including 78,484 tons from Mozambique, 35,019 tons from Angola, 13,425 from Brazil and 9,650 tons from Cuba. This compares with 126,347 tons imported in 1956, including 89,092 tons from Mozambique, 24,990 from Angola and 12,241 tons from the Philippines.

* * *

Argentina Beet Factory.[9]—The foundation stone of a beet sugar factory was laid at Villalonga at the beginning of January 1958. Production of beet sugar was tried in 1939 but was given up in 1942/43. In 1941/42 beet sugar production reached 2000 tons, the highest output ever achieved. Since this time only cane sugar has been produced in Argentina.

* * *

Factories for China.[10]—Three factories of 350 tons/day crushing capacity are to be built on Hainan Island in the Kwangtung district, and a factory of 420 tons capacity transferred to it from elsewhere. Five 350-ton factories are to be erected in Chanchiang, with a sixth of 300 tons transferred from elsewhere. In Hopu one 350-ton factory is to be built and another of 250 tons is to be transferred from elsewhere. A new mill in Auch'ing, Anhui province, will produce just over 30 tons of brown sugar per day on a production schedule of 120—150 days a year.

* * *

Paper from Indian Bagasse.[11]—The Government of India are reported to have granted a license to a private company for setting up a paper factory with an authorized capital of Rs. 30m. (£2·25m.) for the manufacture of paper from bagasse at Mandya, Mysore. Mandya district is a rich cane growing area under the Visvesvaraya canal and there is a sugar factory in which the Government of Mysore holds over 60% of the shares. Messrs. Bedi and Co. who have been given the licence to start the factory have, it is learnt, secured favourable terms from an American manufacturing concern for the supply of the necessary machinery. The Government of Mysore have agreed to participate in the company by subscribing up to 10% of the share capital and the Government will have the power to nominate two Directors on the Board of the new company.

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[1] F. O. LICHT, *International Sugar Report*, 1958, **90**, (Supp. 4), 5.
[2] C. Czarnikow Ltd., *Sugar Review*, 1958, (343), 43.
[3] C. Czarnikow Ltd., *Sugar Review*, 1958, (343), 42.
[4] *W. India Comm. Circ.*, 1958, **73**, 52.
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